DEVELOPMENTAL PSYCHOLOGY

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The Century Psychology Series
Richard M. Elliott, Editor

DEVELOPMENTAL PSYCHOLOGY

AN INTRODUCTION TO THE STUDY OF HUMAN BEHAVIOR

BY

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Growth may be conceived as the creative function of the nervous system, not only with regard to the form of the behavior pattern but also with regard to its control. The creative component of thought, upon this hypothesis, is growth.

Man is more than the sum of his reflexes, instincts, and immediate reactions of all sorts. He is all these, plus his creative potential for the future. . . . The real measure of the individual, accordingly, whether lower animal or man, must include the element of growth as a creative power. Man is indeed a mechanism, but he is a mechanism which, within his limitations of life, sensitivity, and growth, is creating and operating himself.—[From G. E. Coghill, *Anatomy and the Problems of Behavior* (Cambridge: The University Press, 1929).]

TO THE STUDENT

A first book in psychology is in your hands. Its aim is to help you to learn something about how human beings behave and why they behave as they do. Of course you have already learned something about this from observing your own behavior and that of other people. But the chances are that your information is not well organized and that you have little or no inkling of the great body of knowledge that has been amassed by other people who have gone into the matter more systematically. Although a great deal still remains to be learned, psychology has already gone a long way beyond the stage of drawing its conclusions from merely observing fragmentary bits of behavior in a haphazard fashion from time to time. A little can be learned in that way, to be sure, just as we learn a little about the elementary principles of physics by using levers, handling weights, and balancing objects one upon another. But casual experience and everyday observation will not take us very far in either physics or psychology. Exact knowledge depends on carefully planned and controlled experiments. It is on the basis of such experiments that modern psychology has grown up.

So, although you have gained a little knowledge about human behavior from everyday experience, there is still a good deal for you to find out. But because at the outset you are not likely to have much idea about what kind of material you will be given to learn, we have started each chapter in this book with a series of questions, the purpose of which is to turn your attention in the right direction, and to give you something to look for as you read. Go over all the questions carefully before starting to read the chap-

ter. Ask yourself in each case what, if anything, you know about the matter. Then read the chapter, keeping these questions in mind. If your curiosity is lively enough, you will not need to worry much about remembering what you read. Reading in order to find out something that you particularly want to know affords a much better guarantee that you will remember what you read than reading just for the sake of memorizing.

But don't stop with finding out what the book has to say. Psychology, as it is taken up in this book, is especially concerned with finding out the reasons for human action. How often you wonder why some friend behaved the way he did. How often you, too, do something unexpected, something that makes you say, "Now why in the world did I do such a silly thing as that?" Psychology cannot always give us the answer to these questions, particularly in specific instances, for usually we do not know enough about the individual's past experience or about his present organic state to provide the necessary data. But psychology can and does tell us much about the principles to which human behavior conforms, and from a knowledge of these principles we can at least infer, in most cases, why the action in question might reasonably have taken the form it did. The study of psychology will be much more meaningful and valuable to you if, as you read, you try to see how its facts and principles are related to everyday life as you have observed it.

Talking over what you read with some one else is helpful. Don't feel that you must accept everything you read without question. Psychologists themselves do not agree on a good many points; and, while we have attempted here to present a point of view that is not highly controversial, it is but fair to say that some would take exception to certain of its details. So, as you read, you should ask yourself other questions in addition to those given at the beginning of the

chapter. Ask, "Have I ever known people to act like this? Does this theory, or this principle, agree with what I have observed?" Find out what other people think or know about the matter. Discuss, argue. Better still, consult additional authorities; go to the library, and find out what these authorities have to say. That is the way to make learning real. To be sure, you must not take your own unaided observations or opinions as final; but docile, unquestioning acceptance of everything you are told is not the way to become a mature thinker.

Then when you have done all this, go back once more to the questions with which you started and see how you would now answer them. In doing this you should bear in mind that these questions are not intended to serve as a work-book in which one tests his knowledge of separate facts by filling in omitted words or marking statements as true or false. They were put there for the purpose of stimulating curiosity and orienting you with reference to the material to be learned. Satisfactory answers involve more than simple statements of fact. You should be able to tell something of the principles upon which your answers depend, perhaps cite an example or two; and if you can take these examples from your own experience, so much the better. To summarize:

1. Read the questions. Think how you would answer them.

2. Read the chapter with these questions in mind. Recall associated facts from your own experience. Note whether or not your observations accord with the principles stated.

3. Discuss the questions and your answers with other people. Verify specific points from other sources as you are able.

4. Finally, test your knowledge by going back to the original questions once more, answering each in as much detail as possible.

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PSYCHOLOGY: THE STUDY OF HUMAN DEVELOPMENT

Why do different people behave so differently under the same conditions?
How does age affect behavior?
In the same situation, why do not all persons have the same or similar experiences?
How do objects or situations take on meaning for us?
With what is the study of psychology chiefly concerned?

Why Do People Differ?

The next time you go to the theater or to the "movies," notice how the other members of the audience act. A joke is told. Most of the people laugh, some merely smile, others look bored; a few, perhaps, make audible comments of a disparaging nature. Observe their postures. Unless the play is unusually thrilling, most people assume an attitude of easy attention, sitting well back in their chairs with muscles partially relaxed in a position calculated to combine an unobstructed view of the stage with a maximum of bodily comfort. If it is impossible to get a good view and at the same time sit comfortably, some content themselves with such glimpses as they can easily get while others continually twist and wriggle about in their efforts to see more. Some, regardless of the location of their seats, lean forward with set faces and tensed muscles; others loll back with half-closed eyes and seem hardly aware of what is going on. A parcel is dropped with a loud thud. Several persons start

visibly, others crane their necks to see what happened, still others continue to watch the stage with no outward sign of distraction.

But these, you say, are only trifles. Turn, then, to matters of greater importance. Here are five men, each forty years old. As babies you could hardly have told them apart. To-day one is a distinguished statesman, another a farm laborer, the third a bootlegger, the fourth a college professor, and the fifth a garbage collector.

Try to recall the children you played with at the age of eight. Even then, as you will recollect if your memory is fairly good, their behavior was not alike. Some were quick in their movements, others slow; some were fond of companionship and active sports, others were always slipping off by themselves with a book. Some did well in school, others poorly; some usually took the lead in play, others were satisfied to follow; some were always in mischief, others were "good boys" who rarely got into trouble. What are these children like now? Would you say that on the whole the differences between them have increased or diminished as they have grown older? If you had tried to predict from their behavior at the age of eight what they would be like at the present time, in how many cases would your guess have been approximately right? Are there any who have turned out very differently from the way that might formerly have been expected? If so, do you know of anything in their experience or training that might account for the change?

Abilities, habits, and behavior patterns in general do not come full-grown into the possession of their owners like garments bought from a ready-to-wear clothing house. Like the bodily organs, they grow and develop with age. As with the body, their growth and development are determined by laws. As yet these laws are not completely understood, but enough is known to show that, as is true of the laws of

physics and chemistry, their action is relatively fixed and inevitable. Although we cannot change these laws, we can nevertheless make use of them if we learn what they are and how they operate. The differences, little and great, significant and trifling, that you see in the behavior of your friends and in yourself are not the result of chance but have come about through the combined action of growth and experience. To understand them you must know something of the laws of growth and of the factors by which its course is determined.

Growth Is More Than an Increase in Size

All living beings grow. With this growth come changes, not only in size and appearance but in behavior. The baby does not look like a grown-up and he does not act like a grown-up.

He is different. We sometimes say of an acquaintance, "What a babyish face he has!" We do not mean that his face is small; it may even be larger than the average. But the contour of his features reminds us of a baby. Likewise, when we say that some adult is "acting like a baby" we do not necessarily mean that his behavior is simpler, more naïve, less elaborately organized than that of other adults. It is not simply a matter of doing less than we expect, but of doing something different.

Growth, whether physical or mental, is something more than a mere increase in size or an added ability to do things. The adult is not just a big baby, either in body or in mind. He has grown bigger, it is true, and his mental powers have improved. But he has also changed in many other ways that have nothing to do with size or with amount of ability. His bodily proportions have changed. His arms and legs make up a greater part of his body than they did in infancy; his head is smaller in proportion to his trunk. The composition of his bodily tissues has changed. His bones are be-

coming more brittle, his muscles less resilient. His features have become more clear-cut, the chin and lower jaw have increased in size and firmness. As age advances, the layer of fat directly underneath the skin gradually disappears and wrinkles result.

Mental growth, like the growth of the body, is more than a gain in quantity. It is not just a matter of being able to do more things or of being able to do them better. It also involves changes in the way we think and act, in the emotions, interests, and desires that influence all our conduct. These changes are just as truly a part of mental growth as are gains in the ability to memorize, to form correct judgments, or to see relationships, and they merit quite as careful study.

The Relationship of Experience to Growth

Picture to yourself a person reared from birth under conditions controlled by clockwork in such a way that all events in his world occur in a fixed order and nothing new ever takes place. Under these circumstances, would his experiences change from day to day and from year to year or would they be completely controlled by the revolutions of the clockwork?

Before trying to answer this question, think of another and a somewhat similar case. Suppose that a man, after having been totally blind and deaf from birth, were gradually to gain the power to hear and see. Every day, as his senses improved, he would be receiving new impressions, trying out new activities, forming new habits, acquiring new interests, gaining new experiences. Although to every one else his surroundings might remain exactly the same as they were before, to him they would be new and different each day. In like manner, the child reared under conditions of clocklike regularity would nevertheless be constantly finding out new things, having new experiences, as his developing

abilities enabled him to respond to an increasing number of different factors or aspects of his environment in an ever greater number of different ways. It is hard to think of two sets of purely external conditions that could bring about differences in the behavior of two adults that can at all compare with the contrast between the behavior of a normal adult and a normal infant two weeks old in the same surroundings. Although we have no way of knowing just how the world "seems" to the baby, since he is unable to tell us about it, it would be a great mistake to suppose that objects look the same to him as they do to us, that sounds have the same meaning for him, or, in short, that a given set of external conditions constitutes the same "environment" for the infant as for the adult.

The kind of thinking that ascribes to children or animals the same kind of mental processes, attitudes, motives, or desires that we as adults experience is known as *anthropomorphism,** and it has been responsible for many errors in psychological theory and practice. It is an error to which we are all particularly liable, just because we know ourselves so much more thoroughly than we know any one else. Our most common way of attempting to understand others is to "put ourselves in their place." Such a feat of legerdemain is difficult at best, and it may lead to the grossest of errors unless the abilities and limitations as well as the past experiences of the person in question are known and the effect of these abilities, limitations, and experiences upon the way the environment "seems" to him and upon his consequent reactions to it are understood.

So far we have been talking about the "environment" rather loosely. It is time now to attempt to get a clear idea of what environment really is, or perhaps we had better say, of the meaning that we shall attach to it in this book. By

* From the Greek *anthropos* ("man") and *morphe* ("form"); hence, having the form of or resembling man.

the environment of any person we mean whatever objects and events (whether they be material objects, happenings, relationships, actions of other people or what not) are present in his immediate neighborhood and to which *he is capable of responding in some way.* When looked at in this manner, it will be seen at once that environment cannot be thought of as something distinct and apart from the individual but rather as something highly dependent upon the individual, his interests, abilities, and past experiences. A color-blind person has not the same environment as one with normal color-vision, even though they share the same room. To the infant who has not yet learned to speak or to understand language it makes little difference whether the family spends its evenings reading Shakspere aloud or in listening to the latest comic program over the radio. When the understanding is limited, the environment is also limited. As the mind grows, the environment broadens. The relationship is not perfect, because it is possible to rear a very able mind in a very limited environment or to provide an undeveloped mind with many or few situations to which it is able to respond. Nevertheless the association exists, and we cannot afford to ignore it.

The Growth of Meaning

With added experience the environment takes on enriched meaning. Let us return to our hypothetical child reared by clockwork. At times he is fed, and certain events always immediately precede the feeding. It will not be long before these events, whatever they may be, come to stand apart from the rest of the series as something very special. No longer are they simply "a bright object before my eyes," "a warm touch on my cheek," but rather "the signs that my dinner is coming." Under the more variable conditions in which most children are reared, associations are formed somewhat more slowly than it is probable would be the case

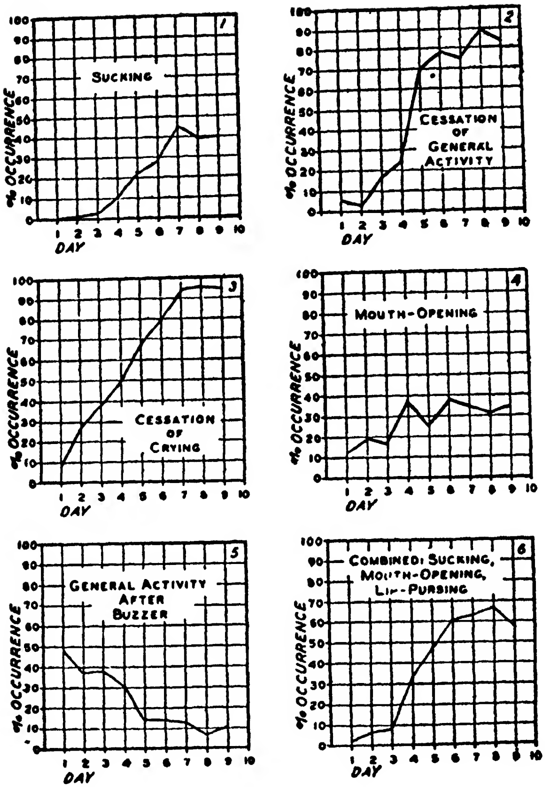


FIGURE 1

THE ESTABLISHMENT OF CONDITIONED RESPONSES IN NEW-BORN INFANTS

This figure shows the day to day changes in response to the buzzer (p. 10) in terms of the percentages of the total number of occasions that the behavior in question was observed. For example, the first curve shows that while the sound of the buzzer did not arouse sucking movements on the first day, an occasional instance of this response was seen on the second and third days. After the third day, sucking in response to the buzzer occurred more and more frequently until by the seventh day the sound of the buzzer elicited sucking movements on 45 per cent of all occasions. The remaining curves are to be read in the same way. For a more complete discussion of the process of conditioning see pp. 181-189.

(From D. P. Marquis, "Can Conditioned Responses Be Established in the Newborn Infant?" *J. Genet. Psychol.*, 1931, 39: 479-492. Courtesy of Clark University Press.)

in such a constant situation as we have described; nevertheless there is enough similarity in the relationships between events from day to day to cause many associations to be formed at a very early age. Marquis * has shown that as early as the first week of life, infants whose feeding-time has always been preceded by the sound of an electric buzzer will show a decrease in general activity and will frequently open the mouth and make suckling movements when the buzzer is sounded. (See Figure 1.) By the age of a few weeks, most babies will stop crying momentarily when the mother approaches the crib, or even at the sound of the mother's voice or footsteps. Later on, sounds linked together in certain ways become such perfect symbols of the objects or events we have learned to associate with them that they are actually used as convenient substitutes for the things themselves. When these sounds are uttered by human beings, we speak of them as "language." As far as our understanding of them is concerned, however, many other sounds have a language function for us. A whistle in the distance tells me that a train is passing, a series of caterwaulings under my window tells me that a cat-fight is in progress. These associations or "meanings" are built up in exactly the same way as the more simple forms by which the baby learns to connect certain events with his feeding-time. Nothing else in human experience, however, approaches human speech in the range and flexibility of the meanings that come to be associated with it.

It is to meanings and not to the simple sensory qualities which underlie them that we respond in our everyday behavior. That pattern of lights and shades I see over there, which I have learned to call a chair, is very much more than a visual pattern. It is a thing to be sat upon when I am tired, a thing to avoid when it gets in my way, a thing to

* D. P. Marquis, "Can Conditioned Responses Be Established in the Newborn Infant?" *J. Genet. Psychol.*, 1931, 39: 479-492.

be climbed upon when I wish to secure something beyond my reach. In a dim light I mistake it for a person, or for a large dog, and I greet it cheerfully or pat it on what I take to be its head. I smile at it when it recalls an absent friend, it brings tears to my eyes when I know that the friend who formerly sat there can never return. Is it the chair, considered simply as a material object, that calls forth all these varied reactions on my part? Not at all. The chair remains the same, but its meaning varies and it is the meaning that determines my behavior. Like other aspects of mental life, meanings, too, grow and change with advancing age.

Psychology, the Study of the Development of Human Behavior

Psychology is sometimes defined as the study of mental activity and conduct. Modern psychology, however, is not content with the separate description of single activities, for events, however important in themselves, lose much of their meaning if considered apart from their normal surroundings and out of their natural sequence. Psychologists to-day are asking not only what a given form of behavior is like but how it came to be so and into what it is likely to develop later on. Psychology is largely concerned with the study of the processes by which early potentialities interact with later experience to form new patterns of behavior, new ways of doing things.

In the course of such a study many special problems have to be considered. It is necessary to know something both of the normal or usual course that behavior patterns follow with advancing age, and of the extent and frequency of the variations from the usual pattern found in individual cases. We need also to know how these variations in behavior have come about. This means that we shall have to study them in relationship to many other factors, such as family history, race, and sex, in addition to the personal

experiences of the people who exhibit them. We wish to know how our own behavior or that of others can be most easily and permanently modified, how learning may be facilitated, how good habits may be formed and undesirable habits broken up. We need also to know something of the physiological factors that influence behavior, and this brings us to a consideration not only of such general bodily conditions as health and disease but to a number of more specialized problems such as the growth and function of the nervous system and of the various sense-organs, the part played by the glands of internal secretion, and other matters of physiological chemistry. And we should not forget, in the study of these relatively concrete matters which the outsider can observe, that there is a great deal going on within the organism which we are unable to see directly and for the study of which no very effective instruments have so far been invented. The impulses we experience, the desires we feel, the interests we acquire, the thoughts we think, the meanings that we ascribe to what goes on about us are just as integral parts of our lives and actions as the movements of our muscles. Probably if all were known we should find that every observable action has as its starting point some intra-organic change. To these changes we give the name of "mental activities"; sometimes for convenience we refer to them collectively as "mind." There is no sharp distinction between the mental and physical activity of a living organism. The mental activity, the change within the organism, is merely the first stage in a single event which may or may not terminate in an external movement that other people can see. We know a little more about our own mental activities than about those of other people, but it is a mistake to think that we know all there is to be known, even about our own. Of the physiological processes involved in these intra-organic changes we get no inkling either from trying to analyze our own thoughts and feelings or from

observing the actions of other people. We know a little about *what* we think, but not much about *how* we think. We often misjudge our own motives. We do many things without knowing why. In reality, while it is true that every person knows a little more about his own mental activities than anybody else can know merely from watching how he moves his arms and legs and the other parts of his body, most of us flatter ourselves into thinking that we know our own minds a great deal better than we actually do.

At this stage we might easily become tangled up in a great deal of metaphysical discussion about the distinction between the mind and the body, but such a discussion would profit us little. The point of view we shall adopt here is that the organism acts as a whole, but that it is sometimes desirable to study certain features of its behavior separately, just as we may examine the spark-plugs of an engine without paying much attention to the rest, although we know that the spark-plugs are not the whole of the engine. So, when we contrast mental activity with physical activity, we mean only that some of the changes which take place in the relationship of the organism to its environment can be observed by everybody, while others are known only to the organism within which they occur. Characteristically, these changes known only to the organism—the intra-organic changes—are the first stages in a given activity which, in many cases, though not always, is continued to a point at which it can be observed by others as well.

I find myself in need of a pencil. This involves some kind of an inner change from a state of satisfaction with refere to pencils to one of dissatisfaction.* So far, no one ept myself knows that anything has occurred, and even

* We do not know in what this change consists, but there is a good deal of evidence pointing to the conclusion that its major features occur somewhere within the outer gray portion or *cortex* of the two great lobes making up the upper forward portion of the brain which are called the *cerebral hemispheres* or, taken together, the *cerebrum.*

I do not know just what has happened in any physiological sense. All that I really know is that some kind of mildly disturbing change has taken place in me that experience has taught me can be relieved by going to get a pencil. Now if the activity spreads outward to include the muscles, if I get out of my chair where I have been sitting quietly all this time and go for the pencil, we call this final part of the activity a physical action because it is observable to others as well as to the subject himself. But the two are not really distinct; they are only earlier and later stages in a single act.

Note further that the mental part of the act might have occurred without the subsequent physical action. I might have felt a desire for the pencil without going to get it, in which case the desire would have been just as real (though perhaps we may raise a question as to its strength), but no one would have known about it except myself. Or the physical act might have taken a different form. Instead of going for the pencil myself, I might have asked some one to bring it to me. Again, the physical action may have had as its starting point something quite different from a desire to get the pencil. Getting the pencil may have been only an excuse. My real motive may have been to escape from a difficult social situation, or to secure a minute's respite from study. We cannot get a complete picture of an activity without knowing both the motive, which is its starting point, and the later stages, which may take the form of muscular action. Both are necessary for a complete psychological description.

As age advances and experience increases, both the internal and the external phases of activity are constantly changing. It is the aim of psychology to learn how these changes take place, how to predict them, and how, when possible, to control them. To do this we must begin early, for actions are not independent of each other but form a continuous series, the completion of one giving rise to the

next. Nor are they independent of the growth of the organism, for acts that would be impossible at one stage emerge at later stages and exert new effects upon subsequent behavior. The study of psychology may therefore be defined as the study of the development of activity, including both its internal and its external phases.

Chapter II

PROBLEMS AND METHODS OF MODERN PSYCHOLOGY

With what kind of facts is psychology concerned?
How does it obtain these facts?
What are the advantages of experimentation in psychology?

The Field of Psychology

In the early stages of any science, a great deal of spadework has to be done in the way of describing, arranging, and classifying the material with which it deals. During this time there is likely to be some friendly wrangling among the workers about what kinds of material should be included, what names should be given it, whether this or that bit of data is significant or worthless.

Since psychology is so young a science, it is not surprising that up to the present time there has been much discussion among psychologists about what kind of facts should be regarded as suitable material for the psychologist to handle. The group of German psychologists led by Wundt were at first very insistent that the field of psychology stopped with the study of sensations and their attributes. They also held that the aim of psychology was to discover general principles and trends only, that it had no concern with the individual person as such, nor with questions about how differences between persons were brought about. In spite of Wundt's lack of sympathy with the problem, however, Cattell, who is one of the pioneers among American

psychologists, began his work on individual differences while he was an assistant in Wundt's laboratory, and it is in large measure due to his efforts that the study of differences between individuals has become such an important part of psychology to-day.

For a time psychologists were much occupied with the study of so-called mental faculties, such as memory, imagination, and attention. These, they believed, were distinct and special powers of the individual, to be observed and studied independently. They were accordingly regarded as the central facts under which psychological material should be classified. Since then we have grown to realize that factors such as these are not distinct from each other, that one cannot, for example, "reason" without at the same time remembering, imagining, and paying attention. We can take the same behavior and classify or describe it in a dozen different ways, depending upon which of its many aspects we choose to observe. We may notice the movements of our subject's arms and hands and describe or classify these movements according to their speed, their accuracy, their force, their gracefulness. Or we may ignore the arm movements and center our attention upon those of his legs and feet, or upon his facial expression, or upon his speech, and here we may give attention either to what he says or to how he says it. Speed, accuracy, grace, memory, persistence, and so on are nothing more than descriptive terms that we sometimes find useful in classifying behavior as it is shown at any particular time. A complete picture of psychology as it is to-day cannot be given in these terms any more than we can take the qualities they are supposed to represent and by putting them together like the pieces of a jig-saw puzzle turn out a real likeness of a human being.

Many other important questions have arisen in the course of psychology's attempts to define its field of interest. One

of the most significant of these is the question whether or not verbal reports about such private and unverifiable data as feelings, sensations, or thought processes have any real scientific value or whether the psychologist might not better confine his attention to the later stages of activity, the external features that are open to general observation. This battle between the "behaviorists" and the "introspectionists" was hard fought for a number of years, but most psychologists now seem committed to a middle ground where data of both kinds are accepted if they seem likely to be useful. If, for example, we are interested in studying food preferences among a group of intelligent adults, it would be unsafe to generalize very far from their behavior, because Smith may be very fond of griddle-cakes but consistently refrain from eating them because they give him indigestion, while Brown may manfully swallow his portion of the rice pudding he detests in order not to disappoint his hostess. If we want to know what foods our subjects like best, we should select a suitable time and place and ask them. But if we are interested in finding out what they eat, the way to do it is to observe them and keep a record. Observation of behavior gives us one set of facts; verbal reports by the subjects themselves give us another. Sometimes one method is to be preferred, sometimes the other. It depends on what we want to find out.

These and other points of controversy that have arisen in the past have served a useful purpose, not only in defining more exactly what psychology is and does, but in suggesting new ways of attacking psychological problems and in correcting extreme and restricted points of view. As time passes and our knowledge increases, other questions will doubtless arise and be debated as hotly as their predecessors have been. The student who finds that the authorities in his subject sometimes hold conflicting views should neither be disappointed nor alarmed. A reasonable amount of controversy

is a sign of health. It is only in death that scientists never disagree.

How Psychology Secures Its Facts

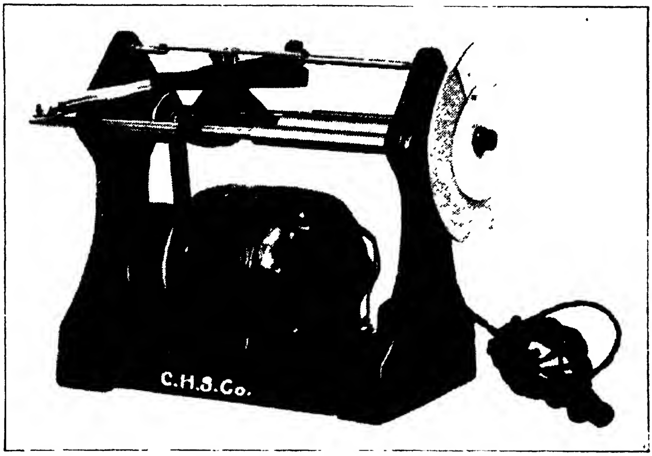
Before psychology can give an organized account of mental activity and of the effect of growth and experience upon the manner in which human beings respond to their environment, it must first of all gather a great many facts. In chemistry we need to know what happens when phosphorus is dropped into water, what compounds are formed when sulphuric acid is poured over zinc, or how to resolve water into the hydrogen and oxygen of which it is composed; in psychology we want to find out what happens when a child's desires are thwarted and how the behavior of a two-year-old, under such circumstances, differs from that of an adult. We want to know how learning takes place and what are the conditions under which people learn fastest and retain longest. We want to know what causes the mind to become diseased, what makes the alcoholic patient see snakes where there are none, and why some insane persons think they hear the voices of angels or of devils urging them to great deeds. Why do perfectly normal people see and do such fantastic things in dreams? Whence come our motives, our interests and desires, and why are people so different in their interests? Why does John like books and school, while Jerry who is in the same class plays truant on every possible occasion? Why is Mary so popular while her sister is shunned and disliked?

The answers to questions such as these cannot be obtained by means of arm-chair theorizing. The modern psychologist is as dependent upon the laboratory for the data with which he works as is the chemist or physicist. His laboratory, however, is not confined to the big room you have seen at the university, with its array of queer-looking instruments and its shelves piled with record forms,

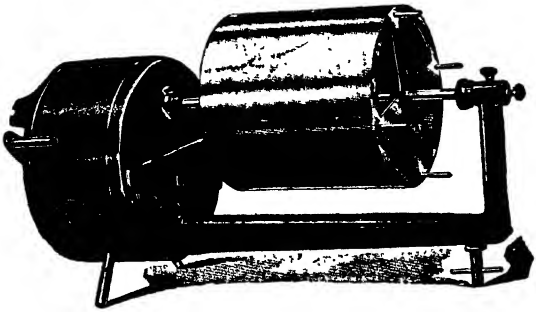
although many psychological investigations are carried out there. Because the psychologist of to-day is interested in finding out how people behave in everyday life as well as how they react to the kind of precisely controlled conditions that can be set up in the formal laboratory, he must extend his observations to the home, the street, the classroom, the factory. The condemned criminal in his cell, the commuter on the 5:15, the new-born baby in the hospital, the genius and the idiot, the butcher, the baker and the candle-stick maker, all furnish their grist for the psychological mill. Armed with a stop-watch and a mechanical counter, the psychologist to-day studies the attention value of various window displays as indicated by the number of people who stop to look at each and the length of time they stay. To-morrow we find him in the school-room conducting experiments in learning or giving psychological tests to discover the special aptitudes and weaknesses of the children in order that their training may be more wisely directed. On other occasions he may observe and record the social reactions of children or adults toward each other, or, back in his laboratory, he may busy himself with photographing the eye-movements of good and poor readers, or with studying changes in heart rate or in the electrical resistance of the skin during strong emotion. Whether they are collected in the seclusion of the formal laboratory or under the more flexible conditions of everyday life, the data of modern psychology are the observed and recorded facts of actual behavior. The psychology of to-day bears slight resemblance to the philosophy from which it sprang.

Methods of Improving the Accuracy of Psychological Observation and of Reducing the Likelihood of Error in Interpreting the Subject's Responses

Every one, no matter how carefully he tries to observe, is likely to make mistakes. He may overlook important



A



B

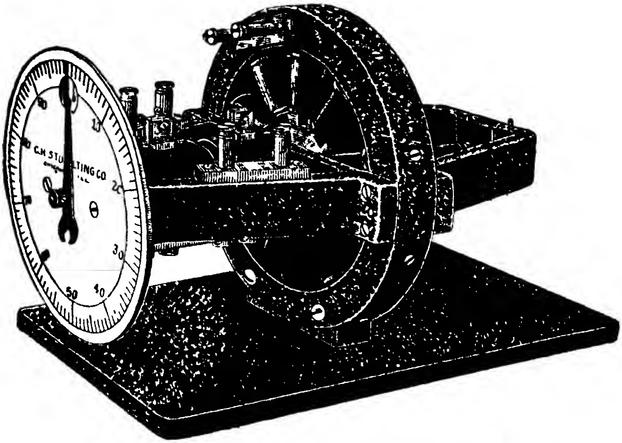
FIGURE 2

SPECIMENS OF PSYCHOLOGICAL APPARATUS

A. Color mixer. For use in studying color vision (see pp. 234). By means of a radial slit, two large cardboard disks of different colors can be overlapped with each other so as to show any desired proportion of each. These are placed on the shaft of the motor driven wheel together with a smaller central disk of standard color. The rapid revolution of the wheel causes the two outer colors to blend and by this means the exact proportions of each color required to match the central disk can readily be determined.

B. A kymograph. The cylindrical drum covered with smoked paper is rotated at a constant slow speed by a spring motor which is concealed in the base. By means of a tambour with a writing attachment which responds to small changes in air pressure, records of breathing, pulse beat, and other bodily movements are obtained.

(Courtesy of C. H. Stoelting Co., Chicago.)



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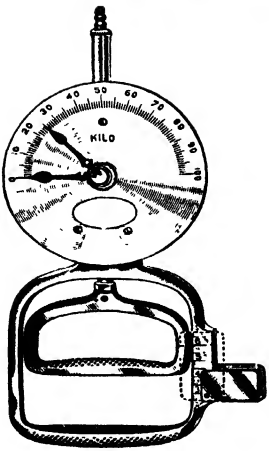

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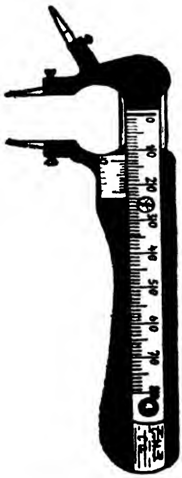


C

FIGURE 3

SPECIMENS OF PSYCHOLOGICAL APPARATUS

A. The Dunlap chronoscope which measures time intervals to 1/1200 of a second.

B. A hand dynamometer for measuring the strength of grip.

C. An æsthesiometer for studying tactile sensitivity as shown by the distance at which two points touching the skin can be recognized as two.

(Courtesy of C. H. Stoelting Co., Chicago.)

features of the behavior he is studying, or be led by suggestion to record events that never occurred. He may make errors in counting, in timing, in measuring. Even more common are the errors of interpretation due to failure to recognize what it is to which his subject is giving attention or to what stimulus he is responding. A mother was greatly impressed by the rapt attention with which her small son listened to the sermon at church. He sat motionless with eyes fixed on the minister, apparently drinking in every word. As they left the church, however, he inquired earnestly, "Mother, did you know that Dr. Brown's back teeth are made of gold? Every time he opened his mouth I could see them shine!"

Whenever a number of different stimuli are presented at the same time, there is danger that an observer may not be able to tell which one is determining the subject's behavior. If the small boy just mentioned had been listening to the same sermon given on a phonograph concealed from his sight by a screen, it would have been easier to judge from his behavior whether or not the sermon itself interested him. One of the main advantages of the formal laboratory experiment as compared to casual observation lies in the possibility of safeguarding interpretation by reducing the number of stimulating conditions to a minimum.

It is interesting to know that experiments in psychology had their beginning in the important discovery that no human being can observe and record with absolute accuracy. In 1796, Maskelyne, an astronomer at Greenwich, found that Kinnebrook, his assistant, was observing and recording the time of stellar transits almost a second later, on the average, than Maskelyne himself did. This was a very serious error indeed, since upon these observations depended the calibration of the clock by which the world's time was regulated, as well as all astronomical calculations about time and space. Although Kinnebrook strove to correct the error

after his attention was called to it, he was unable to do so. If anything it grew worse. Maskelyne therefore decided that Kinnebrook could not be following the accepted method of observation but must have "fallen into some irregular and confused method of his own." Kinnebrook was accordingly dismissed.

Several years later, Bessel, the astronomer at Königsberg, became interested in the matter and decided to find out whether the Maskelyne-Kinnebrook affair was a unique case or whether other astronomers might not also disagree in their observations if put to the test. In 1820, he found an opportunity to compare his own observations with those of Walbeck. It was found that Bessel always observed a transit earlier than Walbeck and that the average difference between their observations was even greater than that found between Maskelyne and Kinnebrook. This discovery led to a number of further investigations from which it became evident that the time required to observe and report any external event will differ from person to person, even when the utmost efforts to secure accuracy are made. This difference came to be known as the "personal equation," and while it was at first considered a problem of interest chiefly to astronomers, its wider significance soon became recognized and many important investigations aimed at determining its physiological and psychological attributes were undertaken.

Since that time, psychologists have been devoting much time to the question of errors of observation, and many important discoveries about the peculiarities of human nature have had their origin in attempts to account for the prevalence of certain kinds of mistakes. Early psychological experimentation was largely concerned with questions of sensation and its attributes. Careful investigations were made of the extent and manner in which color qualities as perceived by us are dependent upon such matters as lighting,

position with reference to other colors (contrast), and whether the colors are seen in direct or marginal vision. As a result of these and many other investigations in the field of the senses, it became evident that small changes in the surrounding conditions may bring about large differences in the appearance of any external object, and that accordingly, unless the external conditions are carefully controlled, the difficulty of interpreting behavior is vastly increased. More recently we have come to see that the internal state of the subject himself, his emotional and physical condition, his level of mental development and his past experiences also exert a great influence upon the way the world looks to him. Although matters such as these are not easy to deal with, their importance at least is recognized and attempts at control are being made.

In psychological investigation, although ideal conditions of experiment are never reached, research workers are continually trying to find ways by which the conditions under which experiments are carried on can be kept under better control and to develop instruments for refining observation and for making records in a more uniform and exact fashion. In the psychological laboratory are to be found chronoscopes for measuring time in units as small as the thousandth part of a second, photographic apparatus of many kinds for making permanent records of behavior that would otherwise be over before it could fairly be seen, galvanometers for measuring electrical changes in the skin, and apparatus for studying other bodily functions such as heart rate, blood-pressure, and changes in the distribution of blood. There are special arrangements for controlling lighting and sound-proof rooms to prevent distraction from outside noises. There are machines for presenting the stimuli to which the subject is supposed to respond, so arranged that such factors as the intensity of the stimulus, its duration, and the intervals between successive trials are kept exactly the same

from one trial to another. There are other instruments for recording the responses made by the subject, thus keeping the results free from the effects of unconscious bias or imperfect observation on the part of the experimenter.

Even when the psychologist leaves his laboratory and sallies forth into the outside world to learn what he can of behavior as it is shown there, he cannot afford to ignore the question of scientific technique. He may not be able to control conditions as he does in his laboratory, but he can and does select from the wide variety of circumstances open to him certain ones in which the conditions that have a bearing on his particular field of investigation are sufficiently uniform for his purpose. Stop-watches, moving-picture cameras, and the like can be carried with him and used where he happens to be, and other pieces of apparatus can often be set up temporarily in the home, the school, the factory, or other places as they are needed. Psychological equipment, moreover, is not confined to pieces of mechanical apparatus but includes also printed blanks for various kinds of tests, questionnaires, rating scales, and standardized interview forms. Even the humble pad and pencil in the hands of one who knows what to observe and how to record his observations in a systematic fashion may yield information of greater scientific value than the most elaborate apparatus will furnish to those unskilled in its use. There are many important aspects of behavior that cannot be studied by means of any mechanical devices now known to us but must be observed and recorded as they naturally occur in everyday life. Social behavior is an example. We cannot weigh it nor measure it; we cannot even start it in operation very effectively. People will not be sociable on request, as every one knows who has had the misfortune to attend a dinner party made up of uncongenial persons. Yet social behavior can be studied, though not as easily as other forms of behavior that are more amenable to control. By making re-

peated observations under different circumstances, comparing the results, and checking the facts for accuracy in as many different ways as possible, even behavior that at first thought appears to be so fluctuating and uncertain as to fall completely outside the field of possible experiment can often be reduced to some form of order by means of a carefully organized system of records. When this is done, it is often found that behavior that appears irrational and unpredictable is consistent enough, once we have got hold of the right key for understanding it.

It is not within the province of this chapter to give a detailed account of the kind of problems the psychologist of to-day is trying to solve or to describe the methods by which he attempts to solve them. But in order to give you a more concrete idea of the number and variety of these problems, we shall add here a brief account of the 1932 meeting of the American Psychological Association. At this meeting 106 papers were presented, of which ninety-two were reports of new experiments. These experiments included studies on the measurement of such personality traits as feelings of inferiority, attitudes toward internationalism, toward the negro, and toward imperialism; studies of work and fatigue, of sensory discrimination, of learning under different conditions and with different incentives, and of the effects of birth injuries on later development; comparisons of the accomplishments of young children with those of apes; studies of the insane and the feeble-minded; animal experiments of many kinds; experiments on the correction of drug habits, on the driving of automobiles, and on the application of psychological methods to the selection of employees; and studies in physiological psychology, mental testing, and memory.

Even from this brief list you can see how impossible it would be to confine ourselves to the use of any single method for solving psychological problems without running

grave risk of developing so one-sided a point of view that our work would become sterile. Methods and techniques do not spring up in a vacuum; they are the tools we construct as we feel the need for them. We find out their inaccuracies and inadequacies by using them, not by letting them lie idle in the hope that by some miracle they will perfect themselves. The method is always the outgrowth of the problems that it is designed to solve. It is the aim of every science to perfect its techniques, but no science would progress far if it refused to use imperfect tools when no others were available.

Chapter III

OUR HEREDITARY BACKGROUND

What do we mean by heredity?
Why are children sometimes like one parent, sometimes like the other, and sometimes like neither?
Why do some plants and animals not breed true to type?
How and when is sex determined?
Why are men more likely than women to be color-blind?
What are the biological advantages of having two parents instead of one?
Will a hereditary trait always show itself in any environment?
Do we inherit habits formed by our parents?
If a mother is badly frightened during pregnancy, is the baby likely to be affected?
What can be said about the relative importance of heredity and environment in bringing about the mental differences we see in our friends?

How Does Human Life Begin?

When people speak of the beginning of life they usually refer to the time of birth. But the life of any person goes back further than birth. In one sense it may be said to begin with the fertilization of the egg-cell, but even this is not strictly its beginning. Life is continuous from one generation to another. The egg-cell at the time it is fertilized is a living bit of tissue that is changing and developing according to its own laws of growth. The sperm by which it is fertilized is also alive. Each was originally part of a living

body, one of the vast numbers of cells of which that body was composed. However, these germ-cells, as they are often called, differ from the other body cells in several important ways, one of which is their ability to detach themselves from the tissue in which they have grown and to live an independent life within the body for a short period of time. But this period of independent life is limited unless something happens to change the course of development and to give to the individual germ-cell a new impetus for growth. If a male germ-cell or spermatozoön meets and fuses with a female cell or ovum, the single cell that results from the fusion takes on a new lease of life. Had they remained apart, both ovum and sperm must soon have died; combined they live and in time develop into a new individual who in his turn will pass on to others the life that has been given him.

In all the higher animals and plants, sexual reproduction is the rule. Even among the lower forms of life that commonly reproduce by simple division of a mature cell to form two new individuals, occasional reproduction by the fusion of two parent cells is seen in the greater number of species. In these cases, the generations immediately following the sexual reproduction commonly exhibit greater vigor than those that preceded it. An increase in vitality thus seems to result from the conjunction of the parent cells even in those organisms that are able to reproduce themselves independently for many generations.

Sexual reproduction has other advantages. Since each new individual represents the convergence of two lines of ancestry, greater possibility of variation is afforded than would be the case if reproduction took place by the division of a single parent cell. As we shall see later, the number of "traits" (by which we mean tendencies to grow and develop in certain ways rather than in others) handed down by each parent is very great, and these may be recombined in the

offspring in a vast number of different ways. The likelihood that any two persons will receive exactly the same combination is very small unless the parents, to begin with, are exactly alike, and in the human race this is never true. Biparental ancestry thus makes for differences between the individual members of the species, and as a result of these differences a complex form of social organization develops. People with special abilities perform certain tasks for which they are particularly fitted, and are repaid by having other kinds of work done for them by persons whose abilities excel along those lines. Modern civilization has in large measure been built up by utilizing the differences between people in the formation of coöperative social groups.

What Is Given by Heredity?

Many people think of heredity as some kind of vague "force" or "influence" that the parent in some unknown way exerts upon the child. This is just as inexact as it would be to think of the reaction that occurs when two chemicals combine to form a new substance as some mysterious force acting upon the chemicals from without. The laws of heredity are simply the rules to which the behavior of the physical substances contained in the germ-cells conforms. Although these laws are not as yet completely understood, much is known concerning them, and the way to further study has been cleared. Just as a chemical reaction consists of the breaking-up of the original molecules into the atoms of which they are composed and the recombination of these atoms into new molecules with different atomic arrangement and composition, so when two germ-cells meet and fuse certain physical substances called *genes*, half of which were originally contained in the sperm and half in the ovum, combine to form a new cell with a *genetic composition* different from either of the parent cells.

We cannot say as yet whether the process is essentially

the same as that of the ordinary chemical reaction or whether it belongs in a separate class, but at any rate the two reactions have many points of similarity. One important difference, however, is found in the fact that whereas the chemical reaction is "touched off" as it were, when the two original substances meet, the genetic reaction begins before the union of the cells. Something in the growth process provides the initial stimulus that causes the dormant cell to grow and change, to reorganize its internal structure and finally to separate itself from the glandular tissue in which it originated and start out on an independent career where it may find the mate without which it must soon die.

The Physical Basis of Heredity

In each sex the germ-cells originate in paired organs known as the *gonads*. The male gonads are called the *testes;* the male germ-cells, the *spermatozoa;* the female gonads are called the *ovaries,* the female germ-cells the *ova.* The ovum or egg-cell differs greatly from the sperm-cell in form and size. In its free state, that is, after it has been extruded from the ovary, the human ovum is a sphere about one tenth of a millimeter in diameter, just visible to the naked eye under favorable conditions. It has no means of locomotion within itself. Its movements are determined solely by the contraction of the tissues by which it is surrounded. The greater part of its bulk is composed of a protoplasmic material known as the *cytoplasm.* The cytoplasm provides the material—for convenience we may call it nutriment though it is really more than that—by which the first stages of development are made possible. Within the cytoplasm is a denser part known as the *nucleus,* which is made up almost entirely of strings or bundles of the genes to which we have already referred.

The spermatozoa, on the other hand, are fashioned for free locomotion under their own motive power. They are

microscopic in size, since they contain very little cytoplasm, and in form are not unlike the tadpoles that you have seen wriggling about in warm, stagnant water in the early summer. There is an ovate head, consisting chiefly of the nucleus which, like the nucleus of the ovum, is composed mainly of bundles of genes. Back of the head is an elongated portion called the body, to which is attached a fine hairlike "whip" or *cilium* that lashes back and forth and so enables the sperm to swim forward through the milky fluid or semen in which they are released.

If the developing germ-cell, either sperm or ovum, is viewed under a microscope, certain very interesting changes can be observed. In the early stages of development the nucleus is seen as a kind of network within which are long-drawn-out chains of minute particles of material arranged in linear order like tangled strings of beads. The enlarged portions of the strings—the "beads"—are called *chromomeres,* and it is probable that they at least show the positions of the genes if they are not the genes themselves. The genes, you will remember, are the physical substances passed on from parent to offspring whose effect in producing and guiding the development of the organism constitutes what we call heredity. It is important to remember that the genes in each string are arranged in a definite linear order that is always the same from one cell to another within a given species.

Later on the strings contract and fold into thick bundles of definite size and form. These bundles are known as *chromosomes.* Examination of the chromosomes shows that they are always arranged in pairs. The two members of each pair are exactly alike in size and appearance. Each one contains the same number of genes, arranged in the same order, so that if the bundles were to be unfolded and the two sets of strings laid out side by side, the genes of each pair would correspond exactly in number and position. More-

over, any two corresponding genes affect the same part of the body or its function, but they do not always affect it in the same way.

The reason for this is very simple. It is known that the cell is the product of two parents. One of the two chromosomes in each pair was received from the father, one from the mother. Throughout all the complicated process of growth and development, throughout the countless number of cell divisions and multiplications, the basic substances re-

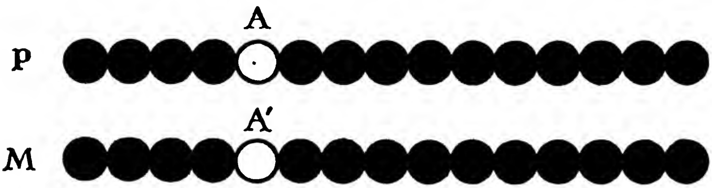


FIGURE 4

DIAGRAM ILLUSTRATING LINEAR ARRANGEMENT OF GENES

ceived from the two parents have maintained their separate identity in the cell. Now that the time has come when they, in their turn, are ready to play a part in the production of a new individual, they are still distinct. Each individual chromosome passes on as a whole.

Examine Figure 4. Here we have represented diagrammatically two chromosomes belonging to the same pair. The upper chromosome came from the father, the lower one from the mother. The genes are shown as beadlike structures joined in a string.

Let us assume that the fifth gene from the left (A—A′) affects eye-color. The upper chromosome (P) of the pair belonging to this cell came from a brown-eyed father and carries within it something, we do not know exactly what, that has the power of producing brown eyes in the child of which this cell may be the starting point. The lower chromo-

some (M) came from a blue-eyed mother and carries the power of transmitting blue eyes to the offspring. Whatever may be the eye-color of the man in whose body the cell bearing this pair of chromosomes originated, his children may have either brown eyes or blue eyes, depending upon circumstances that will be explained later.*

If the cell in its present condition with its full complement of paired chromosomes were to mate with another in the same state, it is evident that the offspring would have double the number of chromosomes possessed by either of its parents. We know, however, that the number of chromosomes is always the same for a given species, although it varies from one species to another. For example, the common fruit-fly, *Drosophila melanogaster,* has four pairs of chromosomes. In man there are twenty-four pairs. This constant number is maintained without increase by a process known as the *reduction division,* which takes place before fertilization, during the process of development in the individual cell. At a certain stage of development the chromosomes separate, one member of each pair passing to one side of the nucleus, the other to the opposite side. As far as we know, chance alone determines the nature of the division. One of the resulting groups may be made up entirely of paternal, the other of maternal, chromosomes, or each group may contain half of each kind or any other combination.

After the chromosomes have separated, the cell divides in such a way that each one of the new cells formed from the division has one member (and only one) of each pair of chromosomes. Each of these single chromosomes now divides lengthwise so that half of each of the "beads" or genes is contained in each part. The halves then move to

* One cannot always tell from the characteristics of the parents what the inherited characteristics of the children will be like. Heredity does not start with the generation immediately preceding. It may go back to the grandparents, the great-grandparents, or for any number of generations.

opposite sides of the cells and the cells again divide as before. From these divisions there result in the case of the spermatozoa four cells where but one was previously, but the new cells differ from the parent cell in having but half the original number of chromosomes. In the ovum a similar process of reduction takes place but with this difference, that at each division most of the cytoplasm remains with one of the newly formed cells while the other half of the divided nucleus with its freight of chromosomes passes off as a microscopic bit of protoplasm known as a *polar body*. The polar bodies are soon absorbed or excreted. In the ovum, therefore, only one functional cell results from the reduction division, and this cell, like the newly formed sperm-cells, contains only one member of each of the original pairs of chromosomes.

Fertilization consists in the penetration of the outer membrane of the ovum by one of the spermatozoa, after which some kind of chemical change takes place by which the membrane is made impervious to other sperm-cells. The sperm that has entered passes directly to the nucleus, where the chromosomes range themselves with the half-set remaining in the ovum so that the cell again has its full complement of genes.

What are the consequences of the reduction division? In each new generation, some of the hereditary traits that the parents received from the preceding generation are lost when the cell divides. Let us return to our earlier illustration of the father who received from one of his parents a gene making for brown eyes and from the other parent one making for blue eyes. After the reduction division has taken place, each of his spermatozoa will contain one of these genes but not both. If it so happens that the ovum is fertilized by a sperm containing the gene for blue eyes, then, for all practical purposes, the paternal ancestry of the resultant offspring is as free from the tendency to produce brown eyes

as if the family tree for countless generations had produced nothing but blonds.

But the paternal ancestry is only half the story. The sperm containing the gene for blue eyes has now mated with an ovum, and in the ovum there is a corresponding chromosome that also contains a gene for eye-color. If it chances that this gene also makes for blue eyes, there is no question as to what will happen. The child into which the fertilized cell develops will also have blue eyes, and moreover, since both its genes are alike, it can transmit only blue eyes, no matter how its chromosomes happen to divide in the next generation.

What happens when the genes are unlike? Suppose that the sperm, with its gene for blue eyes, had chanced to mate with an ovum containing a gene making for brown eyes. What color will the child's eyes be?

One might think, perhaps, that in such cases each gene would have a partial effect, and that the result would be a child with eyes of an intermediate shade. In eye-color, however, as in many other characteristics, blending of this kind does not seem to occur. What does happen is that the offspring resulting from a union of unlike genes will resemble one of its parents in the trait affected by that gene and in this particular trait the gene from the other parent appears to exert no effect. The gene that determines the trait in the offspring is known as the "dominant" gene; that which exerts no apparent effect is called the "recessive" gene. In most cases a single gene is thus sufficient to determine any single characteristic in a child,* but the presence of two genes for each trait nevertheless operates to the great advantage of the individual, as we shall see.

* An apparent exception to this rule occurs in the case of a few characteristics for which the combined action of several genes is necessary to produce the trait. But here, too, only one member of each of the contributing pairs of genes is needed; and as these may all come from the same parent, no real exception is involved.

Dominance and recessiveness are not chance factors, but certain genes always dominate over certain others.* In general it may be said that the dominant gene is the one that carries development furthest. Recessive genes usually make for some kind of mental or physical defect, or for less complete development. Thus the genes making for normal intelligence appear to dominate over those making for feeblemindedness, a gene for normal hearing is dominant over one producing congenital deafness, the genes producing black hair or dark eyes are usually dominant over those producing blond hair and blue eyes. In the example last named, the dominant characteristic has no mental or social advantage. Nevertheless it falls under the general rule, since the process of pigmentation has advanced further in the brunette than in the blond. The rule, however, does not hold good in all cases, since a small number of dominant genes are known that make for undesirable or defective conditions in the offspring. For example, brachydactyly, in which the fingers have but two joints instead of the usual three, is a dominant defect, and so is web-footedness or web-handedness, in which the fingers or toes are joined together by a membrane as they are in the duck. Jennings † suggests that in many, at least, of these cases the dominant defect represents an instance in which development has progressed beyond the normal stage in an abnormal direction. In many of these cases, too, the gene making for defectiveness is only partially dominant and the influence of the normal recessive gene is able to make itself felt to some extent. In such cases of partially dominant defectiveness, the presence of a normal recessive gene makes the defect less pronounced, even if it cannot completely prevent its occurrence.

Let us return to our hypothetical mating of the sperm con-

* With a few exceptions.

† H. S. Jennings, *The Biological Basis of Human Nature* (New York: W. W. Norton and Company, 1930).

taining a gene for blue eyes with an ovum whose corresponding gene produces brown eyes. Since the gene for brown eyes is dominant over the gene for blue eyes, the child resulting from this mating would itself have brown eyes, and since in this case the dominance is nearly complete, the child's eyes would usually be just as brown as if there had been no blue eyes at all in its ancestry. The inheritance is determined entirely by the single dominant gene acquired from the mother. But although there may be nothing in the child's outward appearance to tell us of the fact, deep in his body, in the chromosomes contained in his own germ-cells, the gene for blue eyes that he received from his father still exists unchanged. Paired with it is the gene for brown eyes that came from his mother and determined his own eye-color, but when his time for mating comes, and the chromosomes separate for the reduction division of the cell, the gene making for blue eyes is just as likely to be the one that takes part in the fertilization of a new ovum as is the one for brown eyes. If this occurs and the ovum also carries a gene for blue eyes, the offspring will have blue eyes, because whenever both genes are recessive (and only when both are recessive) the offspring will show the recessive trait.

If, then, we have to do with some one who shows a trait that is known to be dependent upon a recessive gene, we know that both his genes for that trait must be recessive, and that no matter how the chromosomes separate at the time of the reduction division, his own contribution to the determination of that trait in his offspring will always be a recessive gene. If he mates with some one bearing only dominant genes, then the children will all receive one dominant and one recessive gene, and will consequently show only the dominant trait. But the children's chromosomes carry a recessive gene, and when their turn comes to mate, the recessive trait may again appear if they happen to choose

as a mate either some one who, like themselves, carries an unrecognized recessive gene of the same kind or one who has two recessive genes and therefore actually displays the trait.

Consider the possibilities:

1. If either two pure dominants or two pure recessives (i.e., persons who carry two genes of the same kind) mate, all their offspring will be of the pure type and can transmit only dominance or recessiveness as the case may be.

2. If a pure dominant mates with a pure recessive, all the offspring will show the dominant trait and all will carry in their chromosomes one dominant and one recessive gene for that trait, with an equal probability that either of these genes may be transmitted to any of their children.

3. If a pure dominant mates with a person showing the dominant trait but carrying one recessive gene, all the offspring will show the dominant trait, but half of them will receive a recessive gene from one parent which may be passed on to their offspring. Their genetic constitution will be identical with that of the second generation described under 2.

4. If a pure recessive mates with a person showing the dominant trait but carrying one recessive gene, then half the offspring will receive a recessive gene from each parent and will therefore show the recessive trait, while the other half will receive one dominant and one recessive gene and will therefore show the dominant trait but will pass on a recessive gene to half their offspring.

5. If two persons, each carrying one dominant and one recessive gene, mate, on the average, chance matching of the chromosomes after the reduction division will result in one child out of every four receiving a dominant gene from each of his parents, two out of every four receiving one dominant and one recessive gene, and one out of every four receiving two recessive genes. The first three will, of course, all show

the dominant trait, the fourth will show the recessive trait. But among the first three there is one from whose chromosomes the recessive gene has completely disappeared, while the other two still carry one recessive gene that will be passed on to half their offspring. If dominance is complete, as it appears to be in many of the traits that have been studied to date, there will be no way of distinguishing the pure dominant from his brothers and sisters who carry the recessive gene. As generations succeed one another, sooner or later it may happen that a mating will occur in which this hidden gene meets another like itself, and then the recessive trait will again appear. On the other hand, it may happen that none of the cells bearing the recessive gene chance to produce offspring. They may all be lost in the passing-off of the polar bodies from the ovum, or among the millions of spermatozoa that never take part in reproduction. Among some of the lower animals that reproduce frequently and in vast numbers, breeding records will soon enable one to infer with a high degree of probability which of the two possibilities has occurred; but in the human race, where children are few and the interval between generations is long, a recessive gene may be unknowingly passed on for many generations until a mating occurs that brings it into combination with another of its kind, when the recessive trait will again appear. This is the explanation of the oft-observed fact that physical or mental traits frequently skip one or more generations and reappear in children who thus resemble some remote ancestor far more closely than they resemble their parents.

The three-to-one ratio described at the beginning of the last paragraph, which occurs whenever the offspring from the crossing of a pure dominant with a pure recessive are interbred, is often called the Mendelian ratio because of the fact that it was first discovered by an Austrian monk named Gregor Mendel, who became interested in the question of

heredity about the middle of the nineteenth century and conducted a number of experiments on the breeding of peas. Mendel's report of his experiments was published in 1865 in an obscure journal where it attracted little attention and was soon forgotten. In 1900 the paper was discovered by botanists working along similar lines, and Mendel, long since dead, was acclaimed as the father of modern genetics.

Since that time thousands of breeding experiments have been conducted, as a result of which our knowledge of heredity has been greatly extended. We have learned, for example, that while many traits show complete dominance and while, when complete dominance exists, an individual bearing a single recessive gene is indistinguishable from the pure dominant, cases of partial dominance also occur in which the individual with one recessive gene is unlike either the pure recessive or the pure dominant. An example is found in one of the four-o'clocks in which the first generation resulting from the crossing of a pure-bred white variety with a pure-bred red variety bears pink flowers. Another example is seen in a kind of domestic fowl known as the "blue Andalusian" that comes from the crossing of a certain breed of white fowls splashed with blue or black with another breed of black ones, from which poultry breeders long sought to develop a fowl that would breed true to type. But whenever a "blue Andalusian" was crossed with a mate of the same kind, one fourth of the chicks would be splashed white and another fourth black like the original stock, and only half would resemble their parents. No matter how often the poultrymen tried, they could not produce a stock that would breed true. We now know that they failed because they were dealing with a case of partial dominance, and that the fowl with which they were working could never be made to yield a uniform type of offspring because its existence depended upon the presence of two

genes of different kind, neither of which was completely dominant over the other. A stock pure with respect to a particular character can only be produced when both genes for that character are alike.

Sometimes what appears to us like a simple trait is really produced by the combined action of several genes, and in this case the simple three-to-one Mendelian ratio will no longer hold good. Instead some other ratio will be found, its value depending upon the number of the contributing genes and the way they are distributed in the different chromosomes. In other cases any one of several genes is capable of producing a given effect in the offspring. Fortunately, the characteristics that Mendel set out to study in the garden pea all chanced to be cases of complete dominance, each determined by the action of a single pair of genes, so that the fundamental principles were not obscured by the action of special complicating factors that would disturb the relationship. The student should remember, however, that the principles of heredity are much more complex than Mendel's experiments and those of his followers in the early part of the present century would lead one to suppose. But these complications are, after all, details of one and the same fundamental law, known as Mendel's law.

The Determination of Sex

"Is it a boy or a girl?" is likely to be the first question when a new baby is announced. This is not surprising, for few things are more important than sex in shaping the later career of any person. When and how is the sex of the developing ovum determined?

Shortly after the discovery of the paired arrangement of the chromosomes, an important exception to the general rule that every chromosome has its mate was noticed. In every species in which sexual reproduction is the rule, one

sex has been found to have one of its pairs of chromosomes represented only by a single member or, in some species, the unmatched chromosome has a partner in the shape of a very small and rudimentary chromosome that, so far as can be determined, serves no useful function. In most species, including man, the unmatched chromosome occurs in the male, while the female has all her pairs fully represented. It was reasonable to suppose, therefore, that the odd chromosome might have something to do with the determination of sex and later investigation has shown this to be the case. When the chromosomes are segregated at the time of the reduction division, the odd chromosome in the male (often called the X chromosome) ranges itself by chance, sometimes with one set, sometimes with the other. When the cell divides, therefore, half the spermatozoa thus produced will contain an X chromosome, half will not. The ovum, however, has a complete pair of X chromosomes, one of which will always remain in the cell after the polar bodies have been extruded. Now if the ovum chances to be fertilized by a sperm in which the X chromosome has remained, the fusion will result in a cell with a complete set of X chromosomes and the child will be a female. If, on the other hand, the ovum is fertilized by a sperm from which the X chromosome is missing, the result will be a cell that has only the single X chromosome provided by the mother and the child will develop into a male. Since there are as many sperm without X chromosomes as there are with them, it follows that on the average about as many of one sex as of the other will be born.*

* The actual sex ratio at birth is about 105 males to 100 females. Studies of the sex of fetuses that have miscarried show that at the time of conception the excess of males must be even greater. Other evidence, however, shows that the primary explanation for the determination of sex lies in the division of the chromosomes as described above, and that the departure from the expected 50-50 ratio is the result of some disturbing factor that does not affect the general principle. For discussion of this point the student is referred to any recent textbook of genetics.

Linkage and Cross-overs.

One has only to think for an instant of the tremendous number of ways in which people differ from each other in traits that presumably have at least a partial basis in heredity to know that the number of genes possessed by any person must be vastly in excess of the number of his chromosomes. In man there are twenty-four pairs of chromosomes, but the number of hereditary tendencies he receives from his ancestors is far greater. Just how many genes are carried in any single chromosome is not known, but in the fruit-fly, *Drosophila,* whose heredity has been more thoroughly studied than that of any other organism, the position of several hundred genes has been located within its four pairs of chromosomes, and more are being identified each year.

Now since the chromosomes pass over as wholes, it is apparent that characters due to genes located within the same chromosome will tend to be inherited as groups and not singly. Every one has noticed that in families containing both blonds and brunettes in the ancestry, the children as a rule will show either blond or brunette coloring in a whole group of physical traits such as skin-color, hair-color, and eye-color instead of the random assortment we should expect if the genes and not the chromosomes were segregated and recombined at the time of the reduction division. Exceptions occur, but in the great majority of cases the children in such families who have blue eyes will also have blond hair and fair complexions, while the dark eyes of their brothers and sisters will in most cases be accompanied by dark hair and a more strongly pigmented skin. Traits that result from genes in the same chromosome are said to be *linked.* If we remember the way the genes are united in strings, it will be seen that the term is not inappropriate.

In the fruit-fly, *Drosophila.* where the phenomena of

linkage have been most carefully studied and the arrangement of the genes that have been identified so far has been carefully mapped out, a further fact has been noted. When the offspring of controlled matings are studied with reference to the linkage systems that should prevail, exceptions are usually found. For some time these exceptions were very puzzling to geneticists, but we now understand their cause. At a certain stage in the development of the cell, before the reduction division takes place, the chromosomes in each pair come together side by side; sometimes, as seen under the microscope, they seem to be twisted around each other. There is evidence that during this intimate association it sometimes happens that pieces break off and are interchanged, so that when the chromosomes separate for the reduction division the paternal chromosome may have lost some of its genes and had them replaced by the corresponding genes from the maternal chromosome and vice versa. This accounts for the fact that traits usually inherited in groups sometimes break away from their associates and appear in new connections. This is called the *cross-over* action and the transferred genes with the traits that develop from them are known as *cross-overs*.

Sex-linked Traits

Recessive traits that develop from genes carried in the X (or sex-determining) chromosome show a pattern of transmission that differs from the ordinary Mendelian heredity in certain ways. The principle involved is exactly the same, but the fact that one sex has only a single X chromosome causes the principle to work out differently. In man, a number of sex-linked hereditary characteristics are known, and two have been studied rather extensively. There is a hereditary defect known as hemophilia in which the mechanism that causes the blood to coagulate when exposed to the air is so defective that the affected person is likely to

bleed to death from a very slight wound. There is another condition in which the mechanism in the eye for perceiving certain colors is defective. Persons having this defect are said to be color-blind. Color-blindness is of several types and occurs in various degrees ranging all the way from "color-weakness," in which there is greater than normal difficulty in distinguishing certain colors, to very rare cases of complete color-blindness when all colors are seen merely as differing shades of gray as they appear in an ordinary photograph. The most common form is red-green blindness, in which red cannot be told from green. This was not a very great handicap a century ago, but it is one that may have serious results under modern conditions of traffic regulation. Both hemophilia and color-blindness are carried by genes in the X chromosome and are completely or almost completely recessive to the normal genes that accompany them in the female. Their pattern of inheritance will be easily understood if it is remembered that the male has only a single X chromosome and that this chromosome always comes from the mother, for if the father had also supplied an X chromosome, the child would not have been a male.

Let us start with a man in whose X chromosome the gene for hemophilia, or "bleeding" as it is popularly called, is present. In such cases, the man will himself be a "bleeder" because he had no extra gene to protect him, and so the single gene that he received from his mother exercised its full effect. Suppose that this man mates with a woman who has two normal genes with respect to this trait. None of their children will be bleeders because the sons will get their only X chromosomes from their mother who is normal, and although the daughters will each receive a defective gene from their father, the protective influence of the dominant normal gene that comes from the mother will keep the defective gene from exercising any effect upon them. But the defective gene is there, biding its time. If the daughter of

such a mating marries a normal man, half her sons, on the average, will receive from her an X chromosome carrying the defective gene and will therefore be bleeders. The other half will receive the normal chromosome that came from their mother's mother and will therefore be normal. In the case of sex-linked traits, a man who is himself normal need have no fear of transmitting the defect to his offspring, no matter how often it may have appeared in his own ancestry. Any such trait that is carried in his germ-plasm will appear in his own person; if it does not, he may be satisfied that he is free from the taint. But this is not true of the woman in a family where a sex-linked defect is present. Because her sex depends on the presence of two X chromosomes, a single one of which, if normal, is sufficient to protect her from the appearance of the defect, a normal woman with one defective gene will on the average transmit this gene to half her offspring, regardless of their sex. But the males will exhibit the defect; the females will not unless their father is also defective. Since in the general population the normal genes for most of these traits occur far more often than the defective ones, it is much more probable that a normal woman who carries a defective gene will marry a normal man than that she will marry a defective one. If the latter event should occur, however, half her sons will receive from her a defective gene and will accordingly show the defect. She will also transmit a defective gene to half her daughters, and since all her daughters receive a defective gene from their father, half of them will likewise show the trait. This is the explanation for the curious fact that sex-linked traits appear among males far more often than they do among females, but their inheritance in males comes from the female ancestry alone.

Two other possibilities remain. The woman who receives a defective gene from both parents and who accordingly shows the defect may marry either a normal man or one

who carries the same defect. In the first case, all the sons will receive a defective gene from their mother and will consequently show the defect. All the daughters, however, will receive a normal gene from their father as well as the defective gene from their mother and will accordingly be normal themselves but will transmit a defective gene to half their offspring. If a woman with two defective genes marries a man who has the same defect, all the offspring, regardless of their sex, will be defective.

The Protective Effect of Biparental Heredity

As I was writing this, my small niece, whose proclivity for accidents is the despair of her family, came into my study to explain to me that although her mother had forbidden her to go swimming until she had mended her bathing suit, it would be quite all right for her to go because she had found another suit of nearly the same color that she could wear outside the torn one. Although both suits were somewhat the worse for wear, no two holes chanced to coincide in position, and therefore, in her opinion, the combination was entirely adequate for all requirements.

Most of us carry in our germ-plasm a fairly large number of defective genes of one kind or another. Some of the defects that would result from these genes might be fairly serious if they were allowed to come into being. But so long as a defective gene is balanced by a normal gene received from the other parent, the individual is protected in the great majority of cases, since the normal characteristic usually dominates over the defective one. As with the child and her bathing suits, it is only when the defects from both lines of ancestry coincide that harm results. This protection, to be sure, extends only to the individual himself. His children will receive the defective genes unchanged, ready to show themselves for what they are as soon as the protective effect of the normal gene is removed through mating with another

who carries the same defect. It is not within our province here to debate whether or not this all-determining effect of the dominant gene, which protects the individual from the influence of a recessive defect but in so doing conceals its presence without affecting its likelihood of being transmitted to further generations, is in the long run desirable for the race. We can say confidently, however, that because of the protection afforded by having two genes provided for each trait when one would be sufficient, defects of all kinds occur much less frequently than would be the case if we had but one parent instead of two. The latter condition is well exemplified in the cases already described of hereditary defects that are carried in the X chromosome. So far as these traits are concerned, males may be said to have only one parent, for their only X chromosome comes from the mother. If any of the genes in this chromosome are defective, nothing can protect the sons from the consequences. They will always exhibit the defect. But the daughters may receive the same defective genes and yet be normal if the corresponding genes in the second X chromosome that comes to them from the father are normal. Only when both lines of descent are defective will the daughters be affected, while a defect in the maternal line alone is sufficient to bring about the defective condition in the sons.

Mutation: the Mechanism by Which New Traits Appear

In animals and plants that have been bred under controlled conditions for many generations and whose ancestry is therefore well known, it occasionally happens that a change of unknown nature occurs in one of the chromosomes by which a new gene, affecting some part of the body or its functions in a way not previously observed, comes into existence. In the fruit-fly a number of such changes in genetic constitution are on record. They affect such factors

as eye-color, length and form of wing, and abdominal bands. These changes are called *mutations*. Once they occur, they are inherited in exactly the same way as other traits. Most of the mutations on record have proved to be recessive, but a few dominant genes have also appeared in this way.

Until very recently, little was known regarding the factors that affect mutation. Lately it has been discovered that subjecting the germ-plasm to the action of X-rays will cause mutations to occur more frequently, and there is some evidence that they take place oftener in regions where there is much radioactive material in the soil.

Mutations probably occur in the human race as well as in the lower animals, but unless their frequency in terms of generations born is far greater than has been found for organisms such as the fruit-fly, they take place only at exceedingly long intervals. The fruit-fly produces a new generation every ten or twelve days. Counting three generations to a century, it will take more than a thousand years to trace the ancestry of a human family as far as that of a fruit-fly can be followed in the course of a single year. When further allowance is made for the enormous difference in the number of offspring produced by each individual in the human race as compared to the fruit-fly, the absence of authentic records of the occurrence of genuine mutations in human beings is not surprising. If we had any laboratory records of human heredity equaling those available for the fruit-fly in length and accuracy, much that is now uncertain about the inheritance of specific traits in man would be made clear.

Heredity in Relation to Environment

The question is often asked whether a particular characteristic is due to heredity or to environment. The answer must always be that it is due to both. It is not a matter of heredity *or* environment, but of heredity *and* environ-

ment, for neither can operate without the other. From the beginning, growth and development proceed by interaction between the hereditary substances—the genes—that the individual receives from his ancestors, and the new environment in which these genes find themselves. Different genes react in diverse ways to the same environment; the same genes will grow and develop differently if the external conditions under which they develop are changed. In our old friend the fruit-fly there is a gene known as "abnormal abdomen" the effect of which is to cause the abdominal segments to be irregularly shaped, not sharply marked off from each other. This is a recessive gene found in the X chromosome and therefore shows sex-linked inheritance. It appears in males whose mothers carry the defective gene whenever the flies are reared under adequate conditions of food and moisture. But if the food becomes dry and scanty the trait no longer appears, even in males known to carry the defective gene. The production of the abnormal abdomen is therefore dependent both on the presence of the defective gene and on the supply of food and moisture. As Jennings * puts it, "When grown in a moist environment, the difference between normal and abnormal individuals is due to a gene difference, or, as it is usually put, to heredity. If the defective gene is present in all the individuals compared, the difference between normal and abnormal individuals is due to an environmental diversity; to moisture or dryness. The same difference that is produced in some cases by diversity of genes is produced in others by alteration of the environment."

A number of similar cases have been noted in the study of the fruit-fly. There is a gene that produces reduplicated legs which exerts its effect if flies carrying the gene are reared in a cold atmosphere but not otherwise. There is another that causes the number of facets in the eye to be

* *Op. cit.*, p. 130.

reduced, making the eye imperfect. This condition is also dependent upon temperature as well as upon the presence of the defective gene, but in this case the colder temperatures favor normal development. As the temperature under which the flies develop is increased, the number of perfect facets in the eye decreases.

Two principles of major importance may be inferred from these examples. An inherited defect is not always the inevitable, inescapable thing that some people imagine. What is inherited is not the defect itself but a tendency, a constitution that under certain conditions will produce the defect but may not do so if the conditions are changed. Secondly, we cannot tell by any *a priori* process of reasoning what conditions will favor normal development in individuals with defective genes. Take the examples just cited for the fruit-fly. In the case of flies bearing the gene that makes for abnormal abdomen, normal development is favored by the very conditions that a modern social worker among flies would probably try to change, i.e., by a scanty supply of food and moisture. Flies having an inherited tendency to reduplicated legs are more likely to be normal if they are reared in warm temperatures, but those with a tendency to imperfect eyes are more likely to escape when reared in the cold. Experimental breeding has proved these things to be true, but we do not know the reason for them, and they do not tell us how the environment should be modified to prevent other defective genes from exercising their effect.

Can Acquired Characteristics Be Inherited?

Few questions in the field of genetics have aroused more heated controversy than the one just stated. To put it concretely, if parents for many generations are trained to perform a given act, will their children be able to learn it more easily because of the skill acquired by the parents?

After their ancestors have lived for centuries under the rays of a tropical sun, will the babies born to fair-skinned Northern races have swarthier complexions than their progenitors if there is no intermarriage with dark-skinned races during that time?

Many experiments have been conducted in an attempt to answer this question, with results that have upon the whole been negative. Often it has seemed for a time that the results pointed to some effect of parental experience upon the abilities or physical characteristics of the offspring, but in practically all cases it has later been shown that the effects could be explained in terms of selective breeding or other factors making for imperfect control. Social custom has also provided us with many experiments of this kind, and here too the results seem to be negative. The feet of Chinese women have been bound for centuries, but neither the size nor the shape of the feet of Chinese babies has been altered thereby. Certain Indian tribes were in the habit of binding their babies' heads so as to make the skulls assume an odd peaked shape, but the babies continued to be born with normal heads. Generations of fox-terriers have had their tails cut short, but the length of the puppies' tails has not lessened by an inch. Babies whose ancestors for many generations have spoken only German nevertheless have no special predisposition toward speaking German rather than any other language. If adopted at birth into English-speaking homes, they learn English as readily as they would have learned German and speak it without an accent. If they attempt to learn German later on, say in high school or college, the knowledge acquired by their forebears does not give them an hour's advantage over their classmates of English or American stock.

A special phase of this question that has given concern to many expectant mothers is the matter of "prenatal influence." Even intelligent women sometimes believe the popu-

lar superstition that it is possible for an unborn child to be "marked" by some terrifying experience of the mother's, or that its abilities and character can be influenced by the mother's physical and mental regimen during pregnancy. Without going into details, it may be said that the tales reported in this connection are usually just nonsense. Dozens of them have been investigated and found to have no basis in fact or to be easily explainable in terms of other well-known factors without resort to any question of maternal influence. Furthermore, since there is no nerve-connection between mother and child, the mechanism for transmitting a mental experience of the mother to the child is lacking.

Mental Inheritance in Man

The fruit-fly of the biological laboratory, reared in bottles under conditions that can be kept the same from generation to generation or varied at the will of the experimenter, with its thirty or more generations a year and every mating carefully controlled and recorded, affords possibilities for the study of inheritance that in man can hardly be approximated. Yet the close agreement of the facts of human heredity, as far as they have been learned, with those obtained by the experimental breeding of plants and animals leaves little doubt that the fundamental principles are the same for both. Specific facts, however, such as the question of which of two companion genes is dominant over the other, which genes are carried in the same chromosome and therefore tend to be inherited together, and how environment operates to modify inherited tendencies, must be determined separately for each individual trait in man and animal alike. Few of these facts are known with certainty as yet; nevertheless the problem of heredity is one of the most important in the entire field of human behavior. We cannot ignore it, for it underlies every reaction shown by the individual in later life. But we must not be dogmatic

in asserting either its powers or its limitations in any given instance. The same genes in different environments will produce very different effects; under the same environment different genes will develop in diverse ways. If this is true of the physical characteristics of the fruit-fly, how much more likely it is to be true of the mental traits of man in the development of which learning plays so important a part.

The difficulty of studying mental inheritance in man is greatly increased by the fact that most children are reared by their own parents, and, as we all know, experience and training have much to do with determining what people learn to do. Yet experience is not the only factor. The idiot remains an idiot, no matter in how cultured a home he is reared or how careful training is given him. The person with little musical ability may be trained to play and sing after a fashion, but he will not become a real musician. On the other hand, talent that is not cultivated may never display itself well enough to be recognized for what it is. Since parents of superior ability are more likely than others to provide superior advantages for their children, it becomes hard to say to what extent the children's accomplishments are due to native ability and how much of a part has been played by opportunity and training. For this reason the genealogical record as a means of studying the heredity of mental traits is rapidly falling into disuse, though a generation ago it was very popular.

Two methods of distinguishing the mental differences between persons that result from dissimilar heredity—different genes—and those that result from dissimilar environments are commonly employed. One method consists in comparing the resemblances between parents and children who are reared in their own homes with those between foster-parents and their foster-children adopted in early infancy. Similar checks have been made by comparing brothers and sisters reared apart with those brought up

together or by comparing the resemblances of unrelated children reared in the same home with those of true brothers and sisters.

These studies have shown that parent-child resemblance does not disappear when children are brought up from early infancy in foster homes where they have no further contact with their parents. This is true not only of their physical traits but of their mental characteristics as well. Environment undoubtedly exerts some effect, but just how great this effect is likely to be is still a matter of controversy. It is reasonable to suppose that some characteristics can more easily be changed by environmental factors than others, and this seems to be the case. It is unlikely that the color of a child's eyes or hair will be affected by taking him away from his family at birth and rearing him among strangers. Probably his mental abilities will not be greatly changed, though of this we are less certain. But his conduct, the use that he makes of whatever abilities he may possess, is likely to depend very largely upon the conditions under which he has been reared and the particular kind of training he has received. One person of exceptional mental powers may become a great scientist; another, equally gifted, may become a master criminal. Equal ability in no way ensures similar accomplishment.

Another method often used for studying the relative effectiveness of heredity and environment in producing mental differences among individuals is by means of a comparison of the resemblances of identical and fraternal twins. It is now generally conceded that there are two kinds of twins. Among human beings, as a rule, only one ovum matures at a time, and consequently there is only one child at a birth. Sometimes, however, two or more ova may develop simultaneously and both be fertilized at the same time. When the chromosomes of each ovum separate for the reduction division, it is unlikely that the grouping

will be the same. One ovum may receive a preponderance of chromosomes that came from the maternal grandfather of the child-to-be; in the other the grandmother's chromosomes may be in the majority. In like manner the sperm-cells by which they are fertilized will in most cases carry different assortments of chromosomes as a result of dissimilar grouping at the time of the reduction division. The children who develop from these fertilized ova will then, as a rule, carry genes of which some are alike (because by chance it is likely that some of the chromosomes will be the same for each) and others unlike. They will resemble each other in those hereditary traits that develop from similar genes, but may be very unlike each other in traits that arise from unlike genes. This is exactly what happens in the case of ordinary brothers and sisters. We have all noticed that some brothers and sisters are much more alike than others. This is quite to be expected, because it will sometimes happen that the chromosomes divide in much the same fashion on the two occasions, so that both receive about the same assortment of genes, while in the other cases the division may take a very different pattern.

Twins that result from the simultaneous fertilization of two different ova are therefore no more closely related than are ordinary brothers and sisters. They may be of either the same or of different sex. Their heredity may be fairly similar or very different; in rare cases it may be completely different. Because they are really nothing more than brothers or sisters who happen to be born at the same time, they are commonly known as *fraternal twins.*

Twins sometimes originate in another way. After the usual single ovum has been fertilized by a single sperm, it begins to develop by a process of cell-division. Normally, however, the new cells formed by this division do not separate but remain attached to each other, and in this way the body of the new child is formed. At each cell-

FIGURE 5

TWO PAIRS OF FRATERNAL TWINS

The older boys resemble each other fairly closely in coloring, but they differ markedly in height. The younger pair differ not only in sex, but one is a decided brunette, the other a typical blond.

(Courtesy of John E. Anderson.)

FIGURE 6

A PAIR OF IDENTICAL TWINS

(Courtesy of the *Journal of Heredity.*)

division every chromosome divides itself lengthwise, so that every new cell receives a portion of each gene. Now it occasionally happens that at the time of the first division, when the newly fertilized ovum divides to form two, these new cells do not remain together; they separate, and each part develops into a complete individual. Twins formed in this way are known as *identical twins* because they have exactly the same assortment of genes and therefore resemble each other very closely in all their hereditary traits. Identical twins are always of the same sex.

By comparing a large number of such minute physical characteristics as palm and sole prints, form of ear, color and texture of hair, and so on, it is possible to distinguish between identical and fraternal twins with considerable accuracy. Now by noting the mental resemblances found in each group, we can measure roughly the extent to which identical heredity plus very similar environment * can increase resemblances between individuals beyond that which results when the environment is similar but the heredity is only partially similar.

A number of studies of this kind have been made with results that upon the whole agree very closely. In most tests of mental ability, identical twins reared together resemble each other about as closely as two tests of the same person on different occasions, while the resemblance of fraternal twins is about the same as that of ordinary brothers and sisters. In social and emotional characteristics, temperament, and such personality traits as persistence, effort, energy, and so on, the difference between the two groups is usually less marked, a fact which suggests that traits such as these are more strongly influenced by experience and training than is mental ability. However, in every trait

* If we consider only twins of like sex in both comparisons, it is not unfair to assume that the environment is about as nearly the same for both members of a pair of fraternal twins as it is for a pair of identical twins.

studied, identical twins usually resemble each other somewhat more closely than fraternal twins.

A small number of cases of identical twins separated in infancy and reared in different environments have been studied. These cases do not, as a rule, resemble each other in mental and personality traits quite as closely as those reared together; nevertheless the resemblance is far stronger than is found between unrelated persons. In most respects it is stronger than is usually found for ordinary brothers and sisters brought up in the same household. We may separate a child from his family after he has been born, but we cannot separate him from the genes with which he was born.

What shall we conclude from all this? Is our destiny packed up in our germ-cells, fixed and inevitable from the time of our birth? Will heredity alone make from this infant a genius, from that one a criminal? Or, on the other hand, are all men created equal, with similar talents, similar potentialities, equal ability to learn by experience, to persist in spite of difficulties, to foresee consequences and stand fast in the face of temptation?

Neither the one nor the other. No one above the rank of imbecility need be a helpless victim of his hereditary defects if he has any, nor can he depend on his native gifts to take him on his way unaided by his own efforts or without recourse to the advantages offered by education and training. But people are not alike, and those who wish to make the most of themselves will recognize the fact frankly and try to plan their lives in such a way that their natural abilities will be given the fullest opportunity for expression and the defects or weaknesses from which no one is entirely free will be as little of a handicap as possible. We no longer insist that the man with weak lungs shall try to brave the rigors of a New England winter; we send him to a climate that he can stand. We do not try to make an opera singer

from the girl who cannot distinguish one note from another, but instead we try to find out where her talents lie and to direct her training along lines where it seems likely to be most effective. No one need be discouraged because he has weaknesses, nor should he hesitate to look his weak points squarely in the face. Whether they have a hereditary basis or not, they can usually be improved if it seems worth while to do so; if they cannot, the thing to do is to adjust one's mode of living so that they will interfere with it as little as possible. We cannot change our genes, but to a great extent we can determine for ourselves which of them shall be the governing forces in our lives.

Chapter IV

PRENATAL DEVELOPMENT OF THE NERVOUS SYSTEM AND OF THE BODY AS A WHOLE

What is the usual length of the prenatal period? How much does it vary from child to child?

Are the separate parts of the body—the arms, legs, trunk, head, and internal organs—present in miniature from the start? If not, how do they come into existence?

Why is it so essential for the nervous system to lead the rest of the body in growth?

How does the ratio of brain weight to body weight in the new-born child compare with that in the adult?

Which part of the brain grows most rapidly during prenatal life, and why is this significant?

In what respect is the shape of the nerve-cells adapted to the kind of work that they have to do?

Duration of the Prenatal Period

From the fertilization of the ovum until birth, the average length of time is about forty weeks or nine calendar months, but there is much variation from this average in individual cases. Because of some imperfect physical condition in the mother or as a result of accident, children may be born or, as it is popularly expressed, "miscarry" at all stages of pregnancy. Occasional cases have been known to survive that were born as early as six months after conception. Those born much younger than six months, however, if alive at birth, usually do not live more than a few minutes or at

most a few hours. At the other extreme, birth is sometimes delayed for a month or even somewhat more than a month beyond the usual time. The limiting factor here is the growth of the child. If birth is delayed too long, the child is likely to become so large that it can no longer be born with safety either to itself or to the mother. Artificial delivery is usually resorted to if such a condition seems likely to arise.

Roughly speaking, the limits of natal maturity within which the child has a fair chance of surviving may be set at about thirty to forty-five weeks after fertilization. Other factors being equal, its chances are best if it is born at about the usual time, that is, at the age of about forty weeks.

One reason, therefore, why children are not all alike at birth is the fact that, contrary to popular belief, they are not all the same age at birth. If we take the extremes named in the last paragraph as examples, the child born at forty-five weeks is 50 per cent older than the one who is born at thirty weeks. We do not expect the child of six to be as far advanced mentally or physically as the child of nine; we are not surprised that two such children behave differently, show different interests, pay attention to different things. At birth, too, children differ, not only because they have different hereditary backgrounds but because their ages differ.

Physical Development During the Prenatal Period

The speed and complexity of the growth process that goes on during the forty weeks of prenatal life is truly amazing. In this brief period, the organism grows from a single cell, spherical in form and to outward appearance comparatively simple in structure, to an organism made up of billions of cells differing from each other both in structure and in function. There are bone cells, muscle cells, brain cells, skin cells, and many other kinds. The individual cells vary from

each other in size and form according to their position and function in the group. Such complicated organs as the heart, the lungs, the digestive system, the organs of special sense, and the brain and nervous system all have taken on forms closely resembling those seen in later life and are able to function smoothly from the time of birth. The heart beats, the lungs expand and their vesicles fill with air, the blood circulates through them and the red blood corpuscles pick up their freight of oxygen to distribute to the other cells throughout the body. So perfectly has this complicated mechanism been prepared before birth that it functions well enough to serve the child's immediate bodily needs from the time he draws his first breath.

Physical growth takes place in two ways. There is growth by cell-division and multiplication, sometimes called *hyperplastic* growth, through which the various body parts become differentiated from each other, and growth by increase in size of the individual cells, known as *hypertrophic* growth. During the early part of the prenatal period, growth is largely hyperplastic; later on hypertrophic growth predominates.

On the basis of the type of growth most characteristic at the time, embryologists commonly divide prenatal life into three periods. The first two weeks after fertilization comprise the *period of the ovum.* During this time the ovum remains a free organism, existing within the body of the mother but not attached to it, and, so far as we know, not obtaining any sustenance from it. It does not increase in size during this time, but changes greatly in internal structure. The single fertilized cell divides into two, then each of these cells divides again to make four, and so on until a globular mass of cells has been formed. At each of these and of all subsequent cell-divisions each chromosome splits lengthwise so that every new cell formed has a complete assortment of genes.

The first indication of a change in form is the development of a small cavity in the interior of the mass. This cavity is formed by the death of some cells and a rearrangement of others. The cavity gradually increases until two parts are formed: an outer membrane and an inner mass of cells. Two further cavities then form in the inner mass. Between them is a small disk, known as the *germinal disk*. From this disk the child is ultimately formed.

At the end of about two weeks, the ovum attaches itself to the uterus. The outer layer of cells has the power of cutting away the uterine surface, and in this way the ovum becomes completely imbedded in the uterus and surrounded by the blood stream. Only the outer membrane, however, is in contact with the maternal organism. The child now exists as a parasite, taking its nourishment from the mother but living its own life and growing according to its own nature.

The period from the time the ovum attaches itself to the mother and the time when the general form and structure of the body parts have all been laid down is known as the *period of the embryo*. It lasts from about the end of the second to the end of the tenth week. During this period growth in size proceeds at a tremendous rate and differentiation of the bodily parts is brought to about 95 per cent of completion. Thus within the short period of eight weeks, the tiny disk that can only be seen under the microscope changes into an unmistakable human being. To be sure, this human being still differs greatly in appearance from the adult or even the new-born baby. Its head is enormously large in proportion to the rest of the body. (See Figure 7.) The eyes are large and far apart, the arms and legs are tiny. Nevertheless it is a baby, a human being, and not a bird or a puppy. To the trained eye it is not even a monkey, though you or I might have some difficulty in making the last distinction.

The rapid growth in size is quite as remarkable. By the end of the embryonic period the embryo has increased in mass about 2,000,000 per cent. It is then from two to three inches in length and weighs from one-half to one ounce. A waggish mathematician has figured out that if the organism were to continue to double itself in size at the embryonic rate, it would be as large as the whole solar system by the age of twenty-one years. It is just as well that this tremendous rush of growth soon begins to slow down.

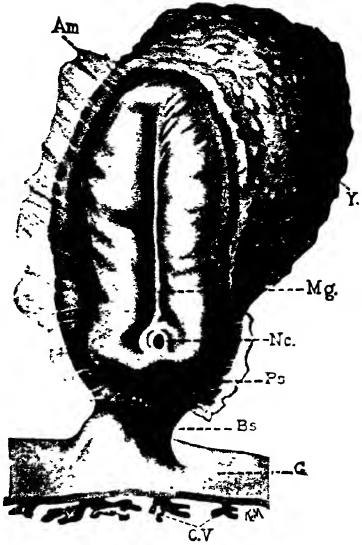
The third and last period of prenatal life is known as the *period of the fetus*. It includes the last thirty weeks before birth. Fetal development is characterized chiefly by growth in size, or perhaps we had better say by growth in "absolute" size, since the time required for doubling either the weight or the length of the fetus is far greater than the corresponding time during the embryonic period. During the first part of the fetal period growth is largely hyperplastic; during the later part it becomes chiefly hypertrophic.

Differentiation of the Body into Parts

The fertilized ovum bears little resemblance to the child into which it will develop later on. The most powerful microscope cannot enable us to distinguish within it anything resembling a human body. Nevertheless from it a human body will grow. But how?

The most plausible answer we have so far is that proposed by Child.* Child points out that the differentiation of the body into parts cannot well be accounted for solely on the basis of the genes, since each cell contains all the genes and yet, as the body grows, the cells in different regions grow to be very unlike each other both in form and in arrangement. The brain is not like the stomach, the liver is not like

* C. M. Child, *The Origin and Development of the Nervous System* (Chicago: The University of Chicago Press, 1921); *Physiological Foundations of Behavior* (New York: Henry Holt and Company, 1924).



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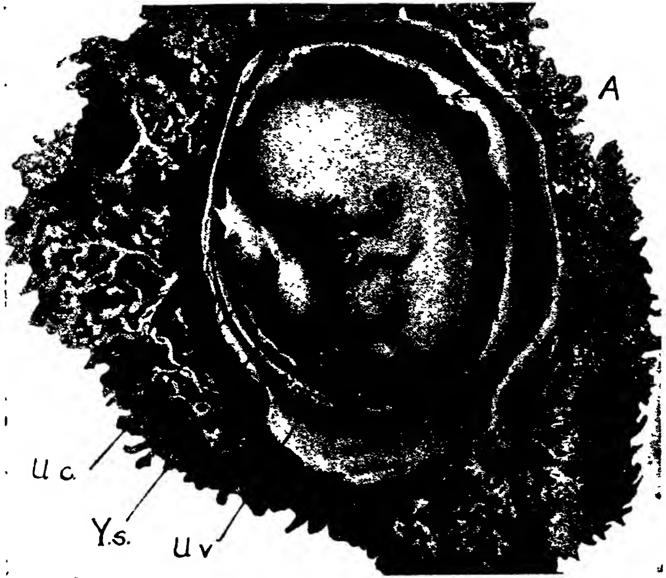


B

FIGURE 7

EMBRYOS AND FETUSES OF DIFFERENT AGES

A. Human embryo 1.54 mm. long (3-4 weeks). After Graf Von Spee.

B. Embryo 19 mm. long (7-8 weeks). U.V.—umbilical vesicle (yolk sac). Y.S—vitelline duct (yolk stalk) U.C.—umbilical cord A.—Amnion.

(From *A Textbook of Embryology* by H. E. Jordan and J. E. Kindred. Courtesy D. Appleton and Co.)

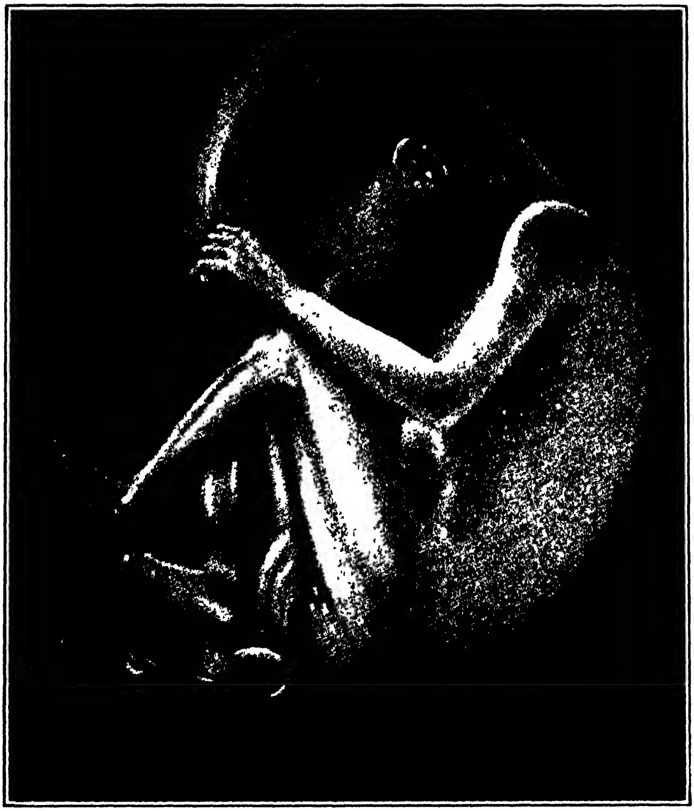


FIGURE 7 (*Continued*)

EMBRYOS AND FETUSES OF DIFFERENT AGES

C. Fetus about three months old. From drawing loaned by Dr. Charles de Forest Lucas.

(From *A Textbook of Embryology* by H. E. Jordan and J. E. Kindred. Courtesy D. Appleton and Co.)

the teeth, the bones are not like the muscles. Nevertheless, all these different parts develop from the single fertilized ovum. If they were not there in miniature at the start, how did they come into existence?

The answer is to be found in the environmental conditions under which the cells develop. At first thought it may seem to you as though the environment of all the cells is the same. But a moment's consideration will convince you that it is not. The cells on the outside of the body have not the same environment as those on the inside, and there are other regional differences as well. Some cells are crowded close together, others have plenty of room to grow. Some receive ample nourishment, others get relatively little. These are just a few examples of the differences in cell environment that are found from one region of the growing body to another.

Experiments carried on with lower animals during the very early stages of development have shown how completely the body as a whole controls the development of its parts. By transplanting certain cells to other regions of the growing body, that is, by changing their environment, almost any cells can be made to transform into almost any part, provided only that this is done early enough, before the transformation into a particular kind of cell is too far advanced. Primitive cells that would normally have become skin cells can be made to develop into the spinal cord if placed in the appropriate region; those that would have become eyes can be made to give rise to brain and so on. Thus we see that the cells which make up the body are never independent units. The single cell from which the child develops need not, in any physical sense, "contain" all the parts that later appear. All that it need contain is a single kind of protoplasm that is capable of developing in various ways according to the influences or "environment" in which it is placed. As the cells multiply, those in certain regions become unlike those

in other regions because they are not subject to the same influences from without the organism or from within it. Certain cells are compressed more than others, some receive a more abundant food supply, in others waste matter accumulates in greater amounts, and so on. Thus the growth and development of one part of the body directly affects the growth and development of other parts. The body, not the individual cells of which it consists, is the fundamental living unit.

Such a highly organized system as the human body can work effectively only if there is communication from one region to another. The hand must work in coöperation with the eye; the internal organs must coördinate their activities if the organism is to survive. This highly important function of supplying a means of communication from one region of the body to another so that all parts may work together harmoniously is supplied by the nervous system. The development of the nervous system is therefore of particular interest to the psychologist in his studies of behavior. In this chapter we shall not attempt to give more than a very brief account of its growth but will merely call attention to some of the main features.

Development of the Nervous System as a Whole

In the development of the child from the germinal disk, the first marked differentiation that can be seen is the formation of a ridge or thickening on the surface. This fixes the axis of the body. Gradually this thickened portion lifts itself above the germinal disk, carrying with it part of the surrounding surface. Eventually the whole thing pinches off except for a small attachment that later becomes the umbilical cord. Along the center of the original ridge the outer layer of cells now begins to proliferate more rapidly than the remainder, thus forming a thickened row of cells running down the center of the back of the developing embryo.

This *neural plate,* as it is called, marks the beginning of the nervous system. A little later on, the center of the neural plate begins to fold in, as shown in Figure 8. The groove thus formed is called the *neural groove;* the edges of the groove, where the developing nervous tissue joins the non-nervous surface layer of cells, is called the *neural crest.* The infolding continues until in about a week's time the

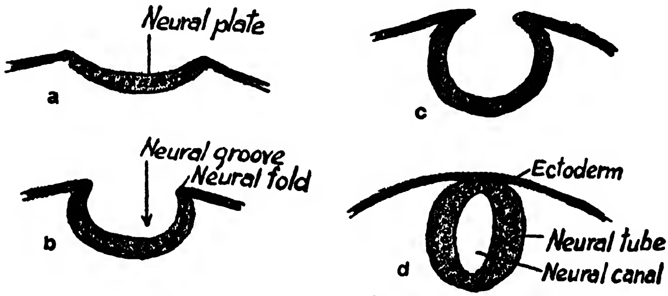


FIGURE 8

SUCCESSIVE STAGES IN THE INFOLDING OF THE NEURAL GROOVE

(From *A Textbook of Embryology* by H. E. Jordan and J. E. Kindred. Courtesy D. Appleton and Co.)

edges of the groove meet and join to form a tube. Successive stages in this process are seen in Figure 8.

The *neural tube* formed by the closure of the sides of the infolded neural groove is the starting point of the spinal cord and brain. Very soon the head end of the embryo can be distinguished from the caudal end by the faster growth of this part of the neural tube. Soon three protuberances appear. These represent the beginning of the brain. They lie at first one behind another at the forward end of the neural tube and are named from the front backward, the *prosencephalon* (forebrain), the *mesencephalon* (midbrain), and the *rhombencephalon* (hindbrain). The spinal cord develops from the caudal portion of the neural tube by a gradual and regular thickening of its walls. The brain results

from a much more rapid but uneven thickening of the forward end of the tube.

Very shortly after the appearance of the prosencephalon, two bulges appear, one on each side. These mark the beginning of the cerebral hemispheres. Their growth is the most conspicuous feature of brain development during the embryonic period, though all the other main divisions of the brain are also laid down during this time. The enormous size of the embryo's head as compared to the rest of its body is almost entirely due to the rush of brain development, particularly cerebral development, during the embryonic period. When we remember that the most conspicuous difference between the human brain and that of the lower animals is to be found in the enormous development of the cerebral hemispheres in man, the significance of this precocious growth of the cerebral portion of the brain becomes apparent. In the early embryonic stages the head includes about half of the total body mass. (See Figure 9.) It is made up almost wholly of the brain and sense-organs, since the jaws and other parts of the head are little developed at this time. The neural tube as a whole represents about 75 per cent of the body mass. From the very start, the nervous system, which is the coördinating and integrating mechanism of the body, takes the lead in growth.

Growth of the Brain

The entire nervous system is thus an expansion of the neural tube. It is made up of an assemblage of nerve-cells or *neurons*. As embryonic growth proceeds, the neurons increase in number by cell-division and multiplication, a process which goes on faster at certain points than at others and so gives the nervous system its characteristic form with the large brain at one end of the spinal cord. Long before the time of birth, unequal growth of the different regions of the brain has served to bring about a partial separation

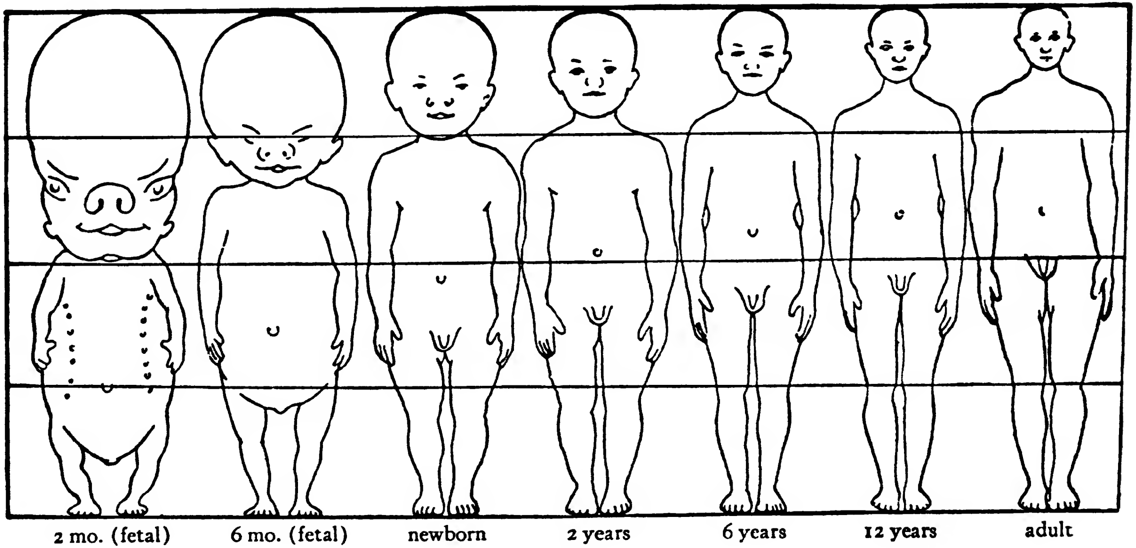


FIGURE 9

CHANGES IN BODILY PROPORTIONS WITH AGE

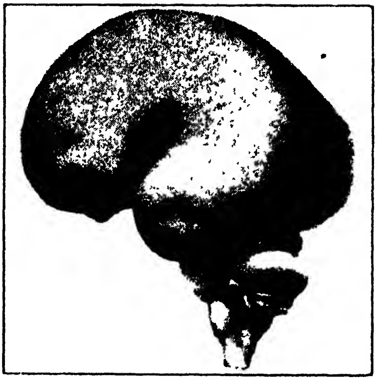
(From chapter on *Developmental Anatomy* by R. E. Scammon in Morris's *Human Anatomy*, sixth edition. Courtesy P. Blakiston's Son & Co.)

of its mass into divisions that bear different names and carry on somewhat different functions. Chief of these divisions in point of size is the cerebrum, which consists of two large lobes at the forward end of the tube. These, by reason of their great size, extend outward and over the other portions of the brain. The cerebrum is the great "association center" of the brain. For a long time it was believed that the nerve centers for different kinds of mental activity were localized in rather definitely marked-out regions of the cerebrum.

Although there is evidence for some degree of localization of brain function, recent investigations have made it seem probable that most kinds of mental activity involve large rather than small areas, and that when parts of the brain which ordinarily are active in certain connections are disabled, in many cases at least their work can be taken over by other parts, though perhaps not as effectively.

Below the cerebral hemispheres at the back of the head is the *cerebellum*. Experiments on the removal of the cerebellum in animals have shown that this part of the brain is particularly concerned with the maintenance of posture. When the cerebellum is removed from a pigeon, for example, the bird can no longer stand. It falls to one side or the other, and though by fluttering its wings and moving its legs it may make a little progress, it cannot keep right side up if it tries to fly or keep from falling if it tries to walk.

A third main division is the *brain stem*, which consists of an enlargement of the spinal cord at the point where it enters the brain. The brain stem is a sort of way-station or distributing point for the fibers that connect the brain and the spinal cord. In addition the brain stem has certain nerve centers of its own. Among these the *thalamus* is of particular interest because it is there that the nerve fibers leading from the eye, ear, and most other sense-organs make con-



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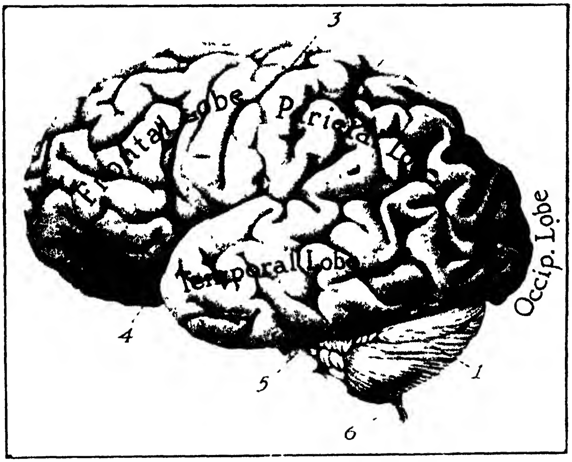

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FIGURE 10

CHANGES IN THE EXTERNAL APPEARANCE OF THE BRAIN FROM THE FETAL PERIOD TO MATURITY

A. The brain of a four-months-old fetus (after Retzius). At this stage the convolutions which are so conspicuous a feature of the adult brain have not yet appeared.

B. The brain of a new-born infant (after Retzius). Apart from the question of size, the external appearance of the infant's brain differs but little from that of the adult. Microscopic examination, however, reveals many unmyelinated regions and other evidences of immaturity.

C

FIGURE 10 (*Continued*)

CHANGES IN THE EXTERNAL APPEARANCE OF THE BRAIN FROM THE FETAL PERIOD TO MATURITY

C. The brain of an adult 1 The cerebellum. 2. The parieto-occipital fissure. 3. Fissure of Rolando. 4. Fissure of Sylvius. 5. The brain stem. 6. The spinal cord.

(From *Psychology from the Standpoint of a Behaviorist* by J. B. Watson. Courtesy J. B. Lippincott Co.)

nection with other fibers leading to the cerebral hemispheres. Within the brain stem, too, appear to be located certain nerve centers that are actively concerned with emotional behavior, a point that will be discussed further in another chapter.

No new cells form in the cerebrum or in the brain stem after birth. Increase in size in these parts of the brain after birth is brought about wholly by increase in the size of the individual cells and by the outgrowth of fibers and the addition of the protective sheath described in a later section. In the cerebellum about 95 per cent of all the cells are formed before birth; in the spinal cord some new cells continue to be formed for about two or three years after birth.

At the time of birth, the brain of an average child weighs from ten to twelve ounces, or nearly 10 per cent of the body weight. In the adult the brain weighs about two and three-quarter pounds on the average, though there is much variation from one person to another. In other words, the brain alone constitutes about one tenth of the weight of the newborn infant but only about one fiftieth of the weight of the adult. And just as the brain as a whole leads the rest of the body in growth, so the cerebrum, which is the part of the brain that shows the greatest difference both in size and in complexity of structure between men and animals, takes the lead over the more primitive, less uniquely human portions of the brain. At birth the brain is about 90 per cent cerebrum, about 7 per cent cerebellum, and about 3 per cent brain stem. The corresponding proportions in the adult are 87 per cent cerebrum, 11 per cent cerebellum, and 2 per cent brain stem.

The Nerve-Cells

For the first three months of prenatal life the nervous system grows almost entirely by hyperplasia, that is, by in-

crease in the number of cells through cell-division. At first these cells are all very much alike; but, as they continue to multiply, differences between them increase until eventually many different forms can be distinguished. Each mature cell, however, includes a cell body with its nucleus and one

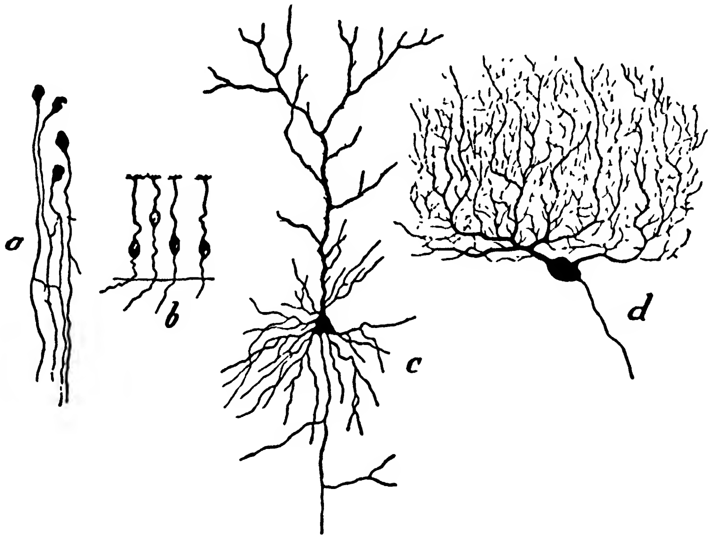


FIGURE 11

DIFFERENT FORMS OF NEURONS

A, unipolar cell; *b*, bipolar cell; *c*, pyramidal cell; *d*, Purkinje cell. (From *Brain and Spinal Cord* by Emil Villiger. Courtesy J. B. Lippincott Co.)

or more fibers by which it maintains its connection with other cells. Some neurons have many fibers growing out from them, others have only one or two. Some of the fibers are of microscopic length; others, such as those making up the nerves that run from the lower part of the spinal cord to the feet, may be as much as three or four feet long. A number of different forms of neurons are shown in Figure 11.

The neurons of the central nervous system in the adult

are divided on the basis of their function into two classes, the *motor neurons* and the *sensory neurons.* The motor neurons are those that control the movements of the muscles and the flow of secretions from glands; the sensory neurons are those that receive impressions from the sense-organs and conduct them inward to the central nervous system as waves of electrochemical energy,* commonly known as *nerve impulses.* All neurons are distinct units in the sense that they never fuse with each other, their fibers simply meeting in such a way that the wave of energy can pass from one to another, much as an electrical current passes from one wire to another when the wires are in contact. The fibers that receive the impulse from another neuron are called *dendrites;* those along which the impulse passes from one neuron into another or into its terminus within a muscle or gland are called *axons.* The point at which the dendrite of one neuron comes in functional contact with the axon or with the cell body of another is called a *synapse.* The synapse is like a one-way turnstile; the nerve impulse can pass through it in only one direction. The impulse comes to the synapse over the axon of one neuron and, as a rule, is taken up on the other side by the dendrites of another. In some cases the synapse is made directly on the cell body of the second neuron. A given mental act may involve few or many neurons, but there is reason to think that the number involved is far greater, as a rule, than was formerly supposed.

Each of the motor neurons is derived from a single *neuroblast* or primitive nerve-cell in the neural tube. From the pear-shaped neuroblast a slender fiber—the axon—first grows out. As it grows it reaches outward toward the marginal

* We do not know exactly how the nervous system works. We do know that by its action bodily organization is maintained and that the nerves are avenues of communication from one part of the body to another. We have referred to the activity within the nerves as a wave of electrochemical energy since that appears to be the view taken by most physiologists of to-day, but later discoveries may necessitate a restatement. The true nature of nerve action has not been determined with certainty.

layer of cells in the neural tube. There it may either change its course and continue to grow within the tube in a direction parallel to the main axis as an association fiber by which other neurons are chained together in the spinal cord, or it

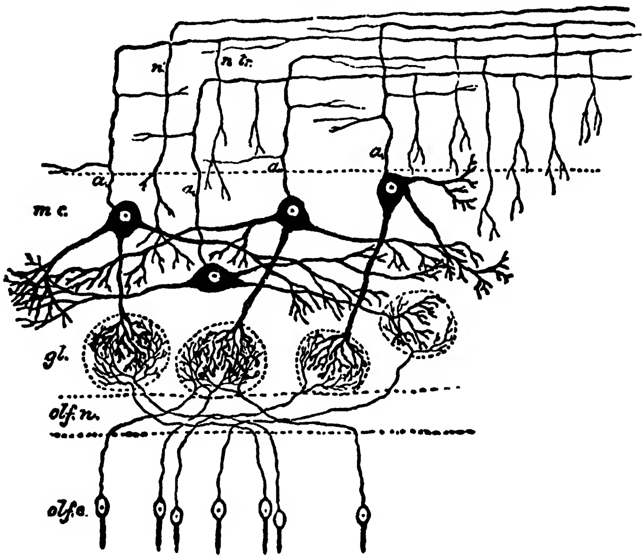


FIGURE 12

DIAGRAM SHOWING SYNAPSES BETWEEN THE OLFACTORY NERVE CELLS LOCATED IN THE NASAL MUCOSA AND NERVE CELLS IN THE OLFACTORY BULB (AN ENLARGEMENT OF THE OLFACTORY NERVE AT THE POINT WHERE IT ENTERS THE BRAIN)

(From *A Textbook of Histology* bv H. E. Jordan. Courtesy D. Appleton and Co.)

may run completely out of the tube and continue to grow in an outward direction until it ends in a muscle, whose contraction it is to aid in governing later on.

The sensory neurons have special end-organs which are sensitive to certain conditions in the external world that produce in us such sensations as cold, warmth, touch, or pain. From the time of their first differentiation the sensory

and motor neurons are distinct from each other. Their origin is different. The motor neurons, as we have just said, arise from neuroblasts within the neural tube, but the sensory neurons come from neuroblasts that lay outside the neural tube. In the beginning the sensory neuroblasts were located in the neural crest, just at the edge of the neural groove. Some of the neural tissue is left outside when the groove closes to form a tube. After the groove closes, these cells migrate outward a little way and there form a series of clusters of cell bodies, known as the *spinal ganglia,* on each side of the spinal column. From each of these cells two primary fibers grow out, but these fibers later join into one and then divide again a little way out from the cell body into two branches. One of these branches grows back into the neural tube and there makes connection with the dendrites of motor neurons. Sometimes the connection is made with neurons in direct connection with the muscles; sometimes with those serving as association neurons; often it is made with both. The other branch grows outward like the axon of the motor nerve and terminates in a sense-organ that can be aroused by certain kinds of external conditions, say by changes in temperature or by the contact of some object. The wave of energy is then carried inward to the central nervous system and is felt as a sensation such as cold or touch.

Let us see how this arrangement works out in after life. One of your sense-organs, let us say an end-organ of touch, is stimulated by some object touching the skin. The fine endings of the sensory neurons that lie within it are aroused to action, and the energy thus generated is transmitted along the external branch of the sensory neuron inward through the cell body and thence, by means of the spinal branch of the neuron, to the spinal cord. There the neuron endings form synapses with the dendrites of other neurons. Some of these have axons that run out to the muscle cells; others

are association neurons whose axons run upward toward the brain. Thus almost simultaneously a number of things can happen. Sensory areas in the cerebrum are aroused, and as a result you "know" that you have been touched. Various association neurons within the cerebral cortex (outer gray portion of the cerebrum) are also aroused, the impulse flashes on to the neurons controlling the muscles that move the eye, and you look to see what it was that touched you. Now the sensory end-organs within the eye are set in action, and the impulse is flashed back by way of the optic nerve to the optical centers in the brain stem. But in order not merely to see but to understand what you see, associations of many kinds must be made; and in order that these may be made, neurons in the cerebrum are again aroused to action. As a result of their action you "recognize" that you have been nudged by a friend, and at the same time realize that he has probably done so for a reason. A fresh set of neurons is now brought into action and by means of a complicated interplay of motor, sensory, and association centers you are enabled to ask him, "What do you want?" Even before this, and probably before you had time to realize that anything had happened, a synaptic connection was made with the motor neurons in direct communication with the part of the body that was originally touched. These neurons at once leaped into action, and as a result the body or some part of it was jerked back automatically without waiting to see whether or not there was need.

All this, just because your friend nudged you with his elbow as a preliminary to borrowing a pencil. Complicated as it sounds, the account given here is unquestionably much simpler than what actually takes place.

The Nerves

The axons that run out from the cell bodies are not scattered at random over the body. Instead they come to-

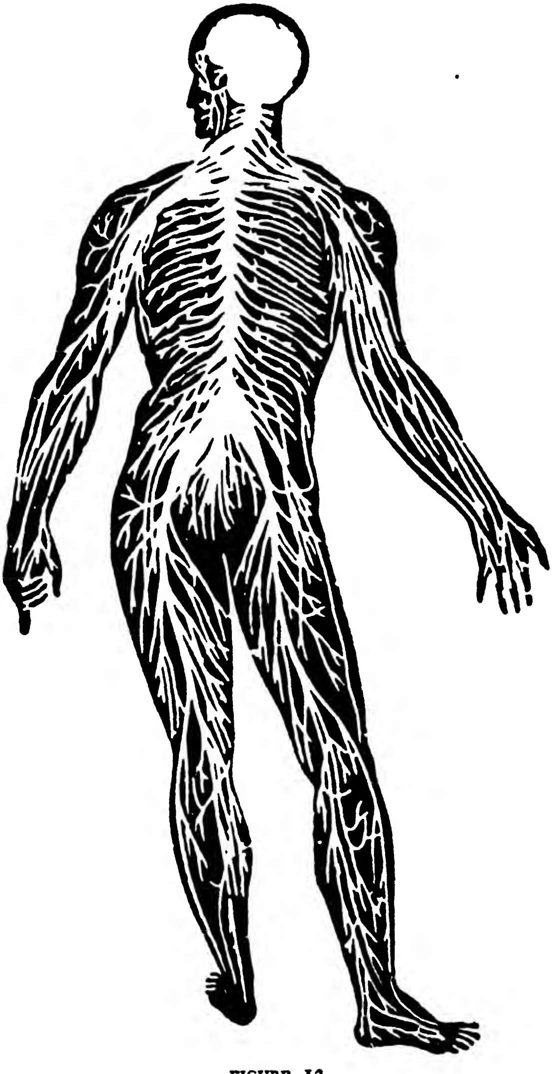


FIGURE 13

DIAGRAM ILLUSTRATING THE GENERAL ARRANGEMENT OF THE NERVOUS SYSTEM

(From Martin's *Human Body*. Courtesy of Henry Holt and Company.)

gether in bundles like the wires of a telegraph cable. The axons of a large number of neurons whose cell bodies are near each other first come together to form one large cable and later separate into smaller branches containing fewer and fewer fibers until at the very end, just before they terminate within the muscles or glands, the single-fiber stage is again reached. These cables made up of the axons of many neurons are called *nerves*. Figure 13 shows how the nerves are distributed over the body.

In the case of a telephone system, when many wires carrying different messages and having different destinations are bound into one large cable, short-circuiting is prevented by having each wire separately incased or insulated by some non-conducting material. In a similar fashion many of the axons, some time after their growth, become ensheathed with a white fatty substance known as *myelin*. It is the myelin that gives the white color to the nerves and to the outer section of the spinal cord. The cell bodies and the dendrites do not become myelinated and are gray in color. Since they lie for the most part inside the cord next to the central canal, a cross-section of the cord reveals a gray portion in the interior with a white section on the outside made up chiefly of the myelin-sheathed axons of association neurons. (See Figure 14.) In the brain the arrangement is reversed. The axons are for the most part found in the interior, the cell bodies and dendrites on the surface. In the brain, therefore, the outside is gray and the inside white, just the opposite of the arrangement seen in the cord. The outer gray surface of the brain is known as the *cortex*.

The axons do not become myelinated until some time after their outgrowth from the neuroblast. Although the process of myelination begins during the fetal period, it is far from being completed at the time of birth. In man, more than half of the axons acquire their myelin sheath after

birth. In some animals myelination is further advanced at birth than in man and is completed at a much earlier age. In general there is a fair agreement between the amount of myelination that has been completed at birth and the animal's developmental level at birth. In animals such as the chick or guinea-pig that can stand and run at birth, prenatal myelination is further advanced than it is in babies or in white rats that are comparatively helpless at birth. Although there is still much controversy over the exact

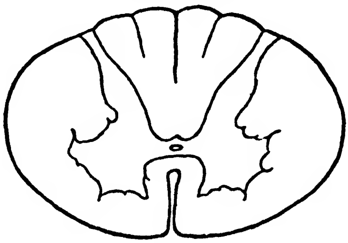


FIGURE 14

SECTION THROUGH THE SPINAL CORD

The gray portion of the cord which is made up of the cell bodies and their dendrites occupies the central portion of the cord, surrounding the spinal canal. Both the size and the shape of the spinal cord vary at different nerve levels. Its transverse area is greatest in the cervical and lumbar regions; it is smallest in the sacral region.

function played by the myelin sheath, there is evidence to show that the neurons which eventually become myelinated do not function properly until the sheath has been laid down. For example, Tilney and Casamajor * found that certain behavior patterns in kittens did not appear until myelination of the neurons had reached a given stage of completion.

Summary

At every stage of its growth the child is an integrated organism in which the whole determines the growth and

* F. Tilney and L. Casamajor, "Myelinogeny Compared to the Study of Behavior," *Arch. Neurol. and Psychiat.*, 1924, 12: 1-66.

development of the parts. The separate parts of the embryo's body do not exist in miniature within the fertilized ovum; they come into existence because the ovum is made up of a certain kind of protoplasm that will develop into those parts if the proper conditions are present. These "proper conditions" are the ones that commonly exist within the body of the mother, and so the individuals belonging to a given species develop in about the same way in the vast majority of cases. But experiments carried on in the physiological laboratory in which the conditions have been deliberately changed show that the separate parts do not develop by themselves in a fixed and unchangeable manner. The entire body is responsible for the growth and development of its parts.

This domination of the parts by the whole demands a system of communication throughout the body and a central organization to assume control over the whole process. The part of the body that performs this all-important function is the nervous system. Since the nervous system is the means by which the whole body is enabled to act as a unit, it is absolutely necessary that its growth should take precedence over that of the other bodily parts, which could neither grow nor function harmoniously in the absence of a system of intercommunication. We have seen that such a rule of precedence exists. The very first of the body parts to be distinguished is the nervous system, and as the body grows this system maintains its lead. Moreover, although the central portion of the nervous system—the brain and spinal cord, within which the major connections and associations are made—is the first part to develop, it always maintains its lines of communication with the more remote parts as they grow. The growth of the general bodily tissues, the bones, muscles, and glands, follows the development of the neurons by which these parts are kept in touch with and subordinate to the development of the whole. Always the

development of the neurons keeps safely in advance of the development of the bodily parts which they innervate. There is never any chance for a single part to get out of control and so block the machinery.

Chapter V

GROWTH AND FUNCTIONS OF THE SENSE-ORGANS

What is the relationship of the sense-organs to the central nervous system? What is the physical basis of sensation?

How does the early development of the sense-organs compare with that of the body as a whole? What other part of the body do the sense-organs most closely resemble in rate of growth? Why is this important?

Why would it be a disadvantage to the organism to have each of its sense-organs sensitive to a good many different kinds of external conditions, that is, to have the eye respond both to light and to sounds and so on?

Does a given temperature as registered by a thermometer always feel the same to us? What conditions are necessary to arouse a sensation of warmth or cold?

In what ways does the structure of the eye correspond to that of a camera?

Why can a very faint star often be seen better if you look a little to one side of it rather than directly at it?

What special apparatus have we to help in keeping our balance? In what way does it work?

How is a sound-wave in the atmosphere transmitted to the central nervous system?

By what means are we able to tell the direction from which a sound comes?

What kinds of sensory experience may the unborn child have? What sensations that we know in adult life is it impossible for him to experience?

The Structure and Functions of the Sense-Organs

The nervous system provides a system of communication by which the body is able to act as a unit and to adjust itself to what is going on within and around it. Thus far, however, we have confined our discussion to the mechanism for transmitting and have had little to say about the arrangements for receiving. But if the organism is to adjust to its environment it must have some way of finding out what the environment is like. There must be some means by which external events such as changes in temperature, sounds, light, contact with other objects, and so on can arouse internal activity, the waves of electrochemical energy within the neurons by which the muscles and glands are stimulated to act. This highly important function is carried on by the *sense-organs.*

The essential quality of a sense-organ is that it must have the property of responding to certain conditions outside itself. The eye reacts to light, the ear to sound-waves in the atmosphere, the sense-organs within the skin to temperature changes, contact, and pain. Each sense-organ responds to one, and as a rule only to one, kind of physical event. We cannot see with our ears or hear with our eyes or smell with the taste-buds in the mouth. Within each sense-organ are the finely branched endings of sensory neurons to which the activity that is aroused in the sensitive tissue of the sense-organ is communicated and from which it is passed on to the central nervous system. Since each sense-organ has its own particular set of neurons which run to a particular part of the brain or spinal cord and make connections there with the association and motor neurons that run to other parts of the body, a system is at once provided for

making a kind of preliminary classification of neural reactions in terms of the particular sense-organ in which they originated. If the nerve impulse comes in to the central nervous system over the neurons whose axons run out to the touch receptors* in the skin on the back of the left hand, the only thing that can have happened to produce that effect is a touch on the skin at the point in question. But if the same sense-organ could be aroused by any one of half a dozen different things, if it responded in the same way to light, to sound-waves, to pain, to cold, and so on, the organism could not make useful adaptations to changes in the world about it because it would have no way of distinguishing them. The limitation of sensitiveness in a given sense-organ to a particular kind of external condition is thus a very great advantage to the organism as a whole because it provides a means by which different kinds of responses can be made to the activities of different sense-organs, which, in their turn, were aroused by different kinds of external conditions.

In addition to the sensitive tissue and the neuron endings within it, many of the sense-organs are also equipped with special parts or accessories that serve to bring them into better contact with the environmental conditions to which they respond. The eye, with its eyelid to protect it from injury, its muscles for turning it about, and its many other special parts which will be described later, is an outstanding example. The amount of accessory apparatus varies greatly from one organ to another. Moreover, the whole organism may respond to a faint or confusing sensation by doing certain things that bring a particular sense-organ into better relationship to the outside stimulus. We walk toward the source of a faint sound, we pick up a small object and hold it at the distance at which it can be seen most clearly, we

* The sense-organs are called "receptors" because they are the receiving instruments for the nervous system.

move our fingers over objects so as to intensify and clarify the touch sensations. Almost any part of the body may be temporarily drafted into the service of one or more of the sense-organs.

Sensations are the responses of the sense-organs and the neurons associated with them. Like digesting, breathing, or excreting, sensing does not have to be learned but occurs automatically under the appropriate conditions as soon as the organism has reached a certain stage of maturity. Although the fetus can have but few sensations because the external conditions that would arouse his sense-organs to activity are for the most part absent, nevertheless the process of maturation goes on so rapidly that all the senses are ready to respond as soon as the child is born. As a matter of fact, studies of the responses of infants prematurely born show that the sense-organs are able to function even before the normal time of birth, though the exact age at which each organ becomes functionally mature has not yet been worked out. Since the sense-organs are the receiving instruments for the nervous system, they are in all ways very intimately associated with it, and they closely resemble it in their mode of growth. The most significant phases of their development all occur before birth, and at the time of birth they are much nearer the adult size than is the body as a whole.*

The Internal Sense-Organs

There are sense-organs that respond to conditions within the body as well as those that react to conditions in the external world. If this were not so, we should not have aches and pains to warn us of indigestion or fatigue; we could not tell when our jaws were moving or whether our elbows were

* This is true of the eye, the internal ear, and the olfactory apparatus. The organs for the other senses are so small and are scattered over such a large area that data on relative size would be very difficult to obtain.

straight or bent without looking to see or touching them with our fingers.

We do not know as much about the internal senses as we do about those with sense-organs on the surface of the body. We know that we have a number of internal sensations such as hunger, fatigue, internal pain. But these senses have no elaborate apparatus like the eye or ear. Hunger has been shown to be directly occasioned by the contractions of the stomach and the alimentary canal which normally occur when certain chemical changes associated with lack of nutriment take place in the blood. This probably means that there are very minute sense-organs within the stomach walls that are responsive to such movements. Thirst results from dryness of the throat. In normal or true thirst, the dryness comes from a reduced action of the salivary glands. These glands respond very quickly to a loss of water from the body by lowering their output. Thirst may also arise from factors unrelated to the supply of liquid in the body. This is the so-called "false thirst" that comes from prolonged speaking or other conditions that dry the mucous membrane of the throat. Internal pain is probably more easily aroused by chemical changes in the body than by mechanical injuries, since physiologists have shown that the viscera may be burned, cut, or crushed without causing pain. Fatigue is a general sensation, which is felt in the muscles and joints all over the body. It is believed to be due to the accumulation of waste products in the blood.

All these organic senses—hunger, internal pain, and so on—seem to function actively from the time of birth and we may infer from this that their sense-organs reach complete or nearly complete functional development before birth. The receptors for these senses are sometimes grouped together under the name of *interoceptors*. They consist chiefly of sensitive nerve-endings located in the internal membranes. They require little accessory apparatus. If we may judge

from his behavior, the new-born baby feels stomach-ache as keenly as we do, the chief difference being that he has not learned to know what is the matter with him.

A second group of internal receptors are known as the *proprioceptors*. These consist of nerve-endings located within the muscles, tendons, and joints. They are stimulated by movements of these parts. Through them we have what is commonly known as the "muscle sense" by which we know the position of the different parts of the body without having to look. These, too, probably reach complete or nearly complete development before birth, but, as with other sensations, the baby has to learn to interpret them. He probably gets much the same sensation from crooking his elbow that we do, but he does not know what it means or from what part of his body it comes.

The External Sense-Organs

1. *The Cutaneous Senses*

The third group of sense-organs, known as the *exteroceptors*, are sensitive to environmental conditions outside the body. They include a series of "skin senses" located within the skin all over the surface of the body, the senses of smell, taste, hearing, and sight, and the less well-recognized sense of head-position through which we are able to maintain bodily balance.

Until the latter part of the nineteenth century, scientists as well as laymen used to speak of the "five senses" as making up all the sense-equipment of the body. Under the "sense of touch" they grouped all four of the cutaneous senses—cold, warmth, pain, and touch—as well as the organic and muscular sensations. We now know that the four cutaneous senses are just as distinct as sight and hearing. They have different sense-organs whose activity is transmitted to the central nervous system over different nerve fibers, and they do not feel the same to us. A cool

breeze yields a very different kind of sensation from a pin-prick; a feather touching the skin does not feel like a hot iron. There are two reasons why the skin senses were formerly confused. Their sense-organs are not conspicuous like the eye and are so near together in the skin that they are often stimulated simultaneously, which makes the separate sensations hard to distinguish. That the skin senses really are separate from each other can be shown by exploring the skin with instruments so small that they are not likely to come in contact with more than one sense-organ at a time. The blunt end of a cold needle or the point of a lead pencil can be used to locate the "cold spots" or sense-organs of cold in a small section of the skin. The inside of the wrist is a good place. Touch the skin gently here and there and it will be found that in some places the needle, as we say, "feels cold." Really, what we feel is not the needle but the response of the sense-organ to the needle. If one of these sense-organs is aroused at all it gives us a sensation of cold, no matter what it is that has aroused it. As a rule the "cold spots" respond only to cold, but it is sometimes possible to stimulate them mechanically, and they can always be stimulated chemically by the application of menthol. A menthol pencil always "feels cold," no matter what its temperature, because it stimulates the sense-organs of cold.*

In a similar way, the sense-organs of touch ("touch spots") can be stimulated separately by touching the skin

* So commonly do we fail to realize that what is felt in sensation is the response of a sense-organ, or more often of a group of sense-organs of the same class located near together in the body, that the untrained person finds it very hard to realize that there is any difference between the qualities of an object and the sensations these qualities arouse in him. Only when a sensation happens to be aroused by something out of the ordinary, as in the case of the menthol pencil mentioned above, does the distinction become really clear. Failure to make the distinction, thinking that a sensation is directly caused by the physical qualities of the objects around us rather than by the action of the sense-organs and their neurons is known as the *stimulus error.*

at different points with a stiff hair or bristle; those for warmth, by using a small, blunt object heated until it is a little warmer than the skin; and the pain spots may be found by exploring with the point of a pin or needle. Very hot or very cold objects may also stimulate the pain spots. The sensations they arouse are likely to be so strong that the feeling of warmth or cold is almost blotted out.

The temperature senses, both for warmth and for cold, have variable thresholds (points at which sensation begins to be aroused) dependent on the temperature of the skin.

Hold your right hand for a few minutes in a basin of very cold water, your left in a basin of hot water. Then plunge both into a basin of tepid water. To the right hand the water will feel warm; to the left hand, cold. "Cold," as we experience it, really means "colder than the skin"; "warm" means "warmer than the skin." The usual skin-temperature in regions exposed to the air is from 85° to 90° Fahrenheit. If the skin is cooled below this point, the temperature senses adapt themselves to the changed conditions. In order to stimulate the cold spots, the temperature must then be lowered below the usual point at which cold is felt, while temperatures that would not usually seem warm will then be felt as warm. If the skin is warmer than usual, the opposite condition arises. Temperatures that normally would seem warm fail to arouse the temperature senses at all, or, if the difference in skin-temperature is marked, they may even be felt as cold. The condition that stimulates the temperature senses is not absolute warmth or cold as shown by a thermometer but a difference between the skin-temperature of the moment and the temperature of the air or the object that comes in contact with the skin. In most parts of the body, a difference of as little as 1° Fahrenheit will arouse one or the other of the temperature senses. If the skin is the warmer of the two, the sense-organs

of cold will be stimulated; if the skin is cooler, the warm spots will be aroused to action.

For the most part, the organs of the cutaneous senses consist of finely branching nerve-endings in the layer of the skin just below the cuticle or outer skin. However, if a section of the skin be examined under a microscope, it is seen that many of the sensory nerves end in little corpuscles or bodies of specialized tissue. These are of several kinds and are generally believed to be receptors for the cutaneous senses. Sensory nerve-endings also tend to cluster about the roots of the short, fine hairs that are found on nearly all parts of the body. When the hair is moved, the nerve-endings are stimulated. The surface hairs may be therefore looked upon as accessory organs for the purpose of increasing the body's sensitivity to touch.

Although we speak of the four senses of warmth, cold, pain, and touch as the cutaneous senses, their distribution is not confined to the skin alone but extends to the mucous membrane and to some extent into the subcutaneous tissue; this is particularly true of the sense of pain. The organs for these four senses are not distributed evenly over the surface of the body but vary in density from place to place. We all know, for example, that the finger-tips are far more sensitive to touch than is the middle of the back and that the outer coat of the eye is extraordinarily sensitive to pain. A grain of dust which, on the skin, would not be noticed at all or at most would arouse a faint tactile sensation, will cause intense pain if it happens to get into the eye. This again illustrates the principle that what is felt in sensation is the response of the sense-organ and not the thing that arouses it.

2. *Smell*

The receptors for smell are located in a small cavity far back in the nose. They are stimulated by tiny gaseous particles of certain substances dissolved in the air. The older

person learns to intensify faint scents by sniffing the air through the nose so as to bring larger quantities of these substances into contact with the olfactory apparatus. The infant does not do this, and for this reason he has sometimes been thought less responsive to odors. It is probable, however, that if other factors could be controlled, the differences in the olfactory acuity of the infant and the adult would be found to be smaller than has been supposed. The matter is hard to check, because the responses to odors are not very characteristic. Unless the odor is very unpleasant and strong, there is not likely to be anything in the infant's behavior that will tell us whether he perceives it or not. The nasal apparatus is very precocious in its growth, which is practically completed during the prenatal period.*

3. *Taste*

The organs of taste are called *taste-buds*. They lie near the bottom of little pits extending down from the surface of the tongue. In the adult and in the older child the taste-buds are chiefly confined to the extreme tip, the edges and the rear part of the tongue, though there are a few on the soft palate and in the back of the throat. The early distribution of taste-buds is very different. At birth and during the latter part of fetal life they are found on the inner surface of the cheeks, all over the tongue, in the throat, on the lips, and even in the larynx. Later on they become localized and increase in number within the areas in which they occur. Thus a much larger area of the infant's mouth is sensitive to taste stimuli than is that of the adult. Whether or not the infant's taste is more acute we cannot say, but experiment has shown that the taste-buds are active at birth.

Taste sensations are much fewer in kind than most people suppose. Most of what we regard as taste is really smell.

* Experiments on the sense of smell in new-born infants will be described in a following chapter.

Blocking the nasal passages so that no air can pass through them causes most of the characteristic flavors of foods to disappear. Every one has noticed that a bad cold in the head which produces partial obstruction of the nasal passages makes all foods taste very much alike. This is not a direct effect of the cold, but occurs because the cold interferes with the sense of smell. Careful investigation has shown that there are only four distinct taste sensations: sweet, sour, salty, and bitter. In the adult or older child sweet tastes come chiefly from the tip of the tongue, sour from the sides, salty from the tip and from the sides, and bitter from the upper surface of the back part of the tongue. These regions have not been mapped out in the infant, however, and because of the very different distribution of the taste-buds, the distribution of the areas for the separate taste sensations is probably not the same.

4. *Sight*

The senses that have the most elaborate apparatus are sight, hearing, and the apparatus in the inner ear by which we maintain balance. All these are very precocious; their development is well-nigh completed at birth.

The eye, which, as we all know, is the organ of sight, is constructed much like a camera. The sensitive nerve-endings in the *retina* correspond to the sensitized plate or film on which the image is projected. In the front of the eye are two strong lenses, the *cornea* and (back of this) the *crystalline lens,* which bend the rays of light as they enter the eye and bring them to a focus on the retina. In the ordinary camera it is necessary to adjust the focus for near and distant objects by changing the distance between the lens and the sensitive plate; in the eye this is done automatically by means of a little muscle, called the *ciliary* muscle, that changes the curvature of the lens as needed. This is a very convenient arrangement; it would be awkward if we had

to stop to adjust our eyes whenever we looked at something nearer or further away as does the old person whose eyes no longer accommodate well and who has to put on one pair

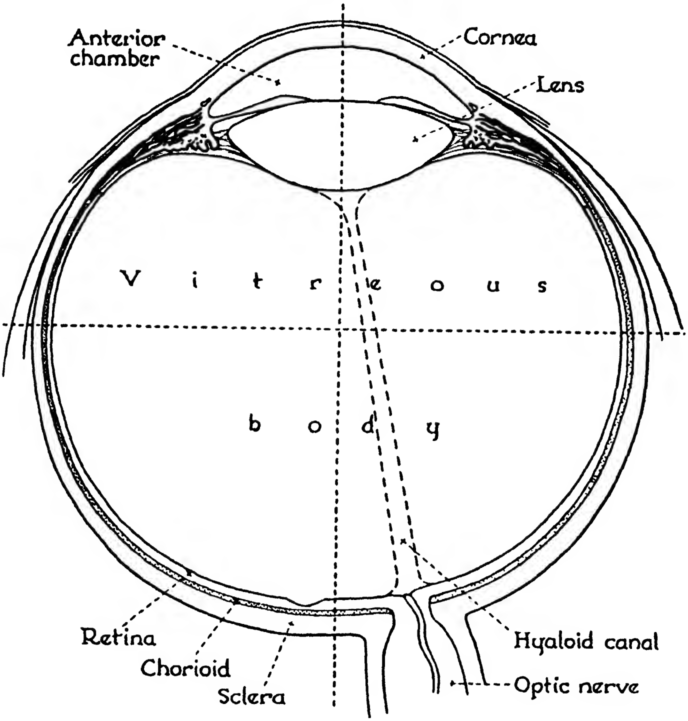


FIGURE 15

TRANSVERSE SECTION THROUGH THE EQUATOR OF THE LEFT EYE SEEN FROM ABOVE

of glasses for reading, another for general use. On the outside, the eyeball is covered with a strong white membrane called the *sclerotic coat* or *sclera;* it is this that we ordinarily speak of as the "white of the eye." The sclerotic coat is lined with a second membrane whose purpose is to absorb any stray light rays that may happen to penetrate the eye except

through the pupil. This coat is black in color and is known as the *choroid coat.* The sclerotic and the choroid coats extend all the way around the eye except for the region in the front that is occupied by the transparent cornea, underneath which the choroid coat is replaced by the *iris,* or colored portion of the eye. The iris is like a colored curtain with a circular hole in the middle, known as the pupil of the eye, through which light is admitted. The cornea in front of the pupil and the crystalline lens behind it together focus the rays of light so that an image of the object from which they are reflected is formed on the retina. Without the lenses we could distinguish light from darkness, but we could not see the forms of objects. It would be like exposing a photographic plate outside the camera. The whole thing would be darkened but there would be no picture.

The eyeball is filled, both before and behind the lens, with a transparent semi-fluid substance that keeps it in shape. The part that lies in front of the lens is known as the *aqueous humor,* that which lies back of it the *vitreous humor.*

The iris is equipped with a series of little muscles that regulate the size of the pupil and hence control the amount of light that enters the eye. They correspond to the diaphragm of a camera. You have all noticed how the size of the pupil enlarges after having been in the dark for some time and how it contracts on exposure to strong light.

In the retina are the sensitive cells that react to light. These cells are of two kinds, called from their shape the *rods* and the *cones.* (See Figure 16.) They lie at the back of the retina. The layer of retinal cells which is next to the rods and cones contains pigment, and it is thought that the incoming light produces some chemical change in the pigment which stimulates the rods and cones. The endings of the sensory nerve fibers (the optic nerve) enter the bases of both the rod cells and the cone cells.

You know that you see an object most clearly when you look directly at it, although you also see the objects near it fairly well. This is because the part of the retina that lies

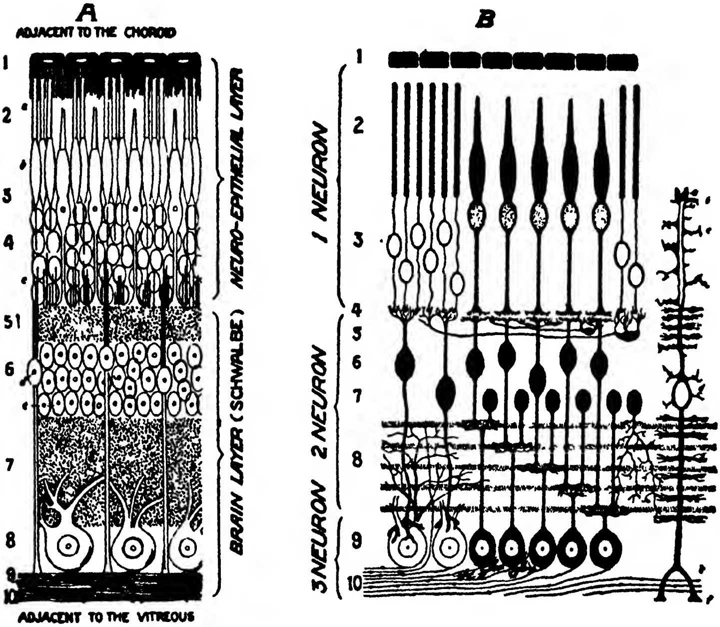


FIGURE 16

DIAGRAM OF THE HUMAN RETINA, SHOWING THE RELATIONSHIPS TO EACH OTHER OF THE RETINAL NEURONS AND THEIR DISPOSITION IN THE DIFFERENT LAYERS OF THE RETINA

The retina may be said to be formed by an expansion of the fibers of the optic nerve which enters the eye from the back, pierces the sclerotic and the choroid coats and spreads out over the inner surface of the eyeball. Ten separate layers can be distinguished under the microscope. These layers are composed of three neurons which form synapses with each other as shown above. The outer layer of the first neuron is the pigmented layer mentioned on p. 94. The second layer is the layer of rods and cones. Synapses between the neurons are made at the fourth and the eighth layers. The tenth layer consists of the fibers of the optic nerve which pass back to the brain. These layers are numbered from the outer surface of the retina inward toward the center of the eyeball.

(After Fox's *Ophthalmology.*)

directly back of the pupil of the eye and is called the *fovea* contains very many cones and no rods at all. The cones are the most sensitive cells; they respond best both to form and color. As you go out from the fovea an increasingly greater number of the cones are replaced by rods. The rods are entirely insensitive to color; however, they respond to changes in light and shade (that is, to form), though not as well as the cones. They have one great advantage over the cones, which is that they become adapted to very dim lights better than the cones do. In deep twilight we cannot distinguish colors at all, because the rods and not the cones are functioning at that time. There is some reason to think that cone-vision does not develop as early in life as rod-vision; at all events, as we shall see, the young infant does not seem to respond selectively to color. We shall return to the question of color-vision in a later chapter.

The prenatal development of the eye is interesting. Within a few days after the attachment of the embryo, an expansion of the neural tube occurs near the forward end on each side. From each of these there develops a "primary optic vesicle," as it is called, which grows forward toward the skin and assumes the form of a hollow sphere. The cavity inside the sphere remains in communication with that part of the neural tube which is developing into the brain * by means of a hollow stalk. While the primary optic vesicle is being formed, the skin of the face becomes thickened at a point opposite the outgrowing optic vesicle. The thickening increases on the side toward the optic vesicle until it comes

* Evidence of the tubular origin of the brain and spinal cord persists throughout life. Although the walls of the tube become greatly thickened, they never completely close. Within the spinal cord a small central canal persists that runs throughout its length. In the brain, due to the uneven thickening and infolding of its walls, the central canal widens out into a series of larger cavities known as "ventricles" that are connected with each other by narrow passages like a chain of lakes. Thus all parts of the original tube remain in communication with each other throughout life. Both the spinal canal and the ventricles of the brain are filled with a liquid known as the *cerebrospinal fluid*.

in contact with it. From this thickened portion of the skin the lens of the eye is formed. When the two meet, the optic vesicle collapses like a rubber ball from which the air has been expelled, and a secondary optic vesicle whose walls are two-layered is formed by the closing-in of the open side of the hemisphere around the lens which now lies within it. This secondary optic vesicle becomes the eyeball. It is filled, as the eye grows, by the aqueous and the vitreous humors. From the outer layer of cells come the outer coats of the eye. The inner layer forms the retina. The sensory nerve-endings at the base of the rods and cones maintain their connection with the brain by a series of fibers comprising the optic nerve that extends back to the brain through the hollow stalk mentioned on page 96.

Fundamentally, therefore, the eye is a part of the brain that has migrated outward to the surface and there taken on certain accessory parts. Its growth during prenatal life and early childhood closely resembles that of the brain. All the fundamental parts have been organized by the seventh prenatal week. At birth it is half as large as it ever will be, while the body as a whole is only about a twentieth of its final size. Of the different parts of the eye, the retina is nearest to full growth at birth; it is then two-thirds as large as it will ever become. However, there is probably some further differentiation of its finer structure after birth, as we shall see later on.

You may have noticed that the eyes of babies and young children are further apart than those of older people. During prenatal life this difference is even greater. At an early embryonic stage the angle between the eyes is about 180°, that is, the eyes are on opposite sides of the head as they are in some animals. (See Figure 17.) As growth proceeds, they migrate forward and become nearer together, until at birth the angle is about 90°. After birth the angle continues to decrease slightly throughout childhood.

5. *The senses of hearing and bodily equilibrium*

Sound is caused by waves or vibrations in the external air. Roughly, we perceive as sounds vibrations that occur at the rate of twenty to 20,000 per second, the slower vibrations with longer wave-lengths producing sounds that are

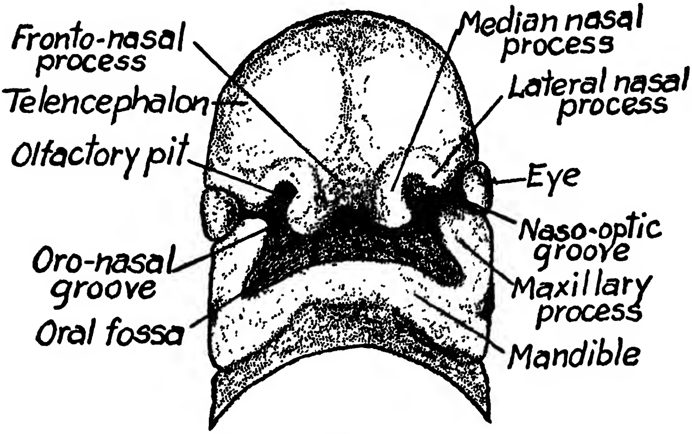


FIGURE 17

UNDER SURFACE OF THE HEAD OF A HUMAN EMBRYO ABOUT TWENTY-NINE DAYS OLD

(After His, from Gray's *Anatomy*)

low in pitch and the faster, shorter vibrations producing the high pitches.

The difference between musical tones and noises is due to differences in the character of the sound-waves. Musical tones come from waves that are regular and even; noises, from waves that are broken and irregular in sequence. Pure tones result from waves that have a simple and uniform pattern, with each wave like the preceding one; complex tones from waves that have a more complicated though rhythmic pattern, with little waves superimposed upon or interspersed between the larger ones. But strictly pure tones

are rarely heard because any material substance tends to vibrate not only as a whole but in parts. Careful observation of a violin string when it is lightly bowed will reveal this tendency to vibrate in halves or thirds in addition to the fundamental vibration of the whole string. These partial vibrations produce faint complementary sounds which are higher in pitch than the fundamental and hence are known as overtones. The differences in tonal quality, in timbre, by which we are able to distinguish one musical instrument from another are the result of the variations in the form of the sound-waves caused by the number and character of the overtones.

The ability to localize sounds depends in part upon the relative intensity of the sounds at the two ears and in part upon differences in phase, i.e., the fact that the crests of the sound-waves entering the two ears will not exactly coincide in time, hence the successive stimulations of the auditory sense-organs will occur at different intervals. We learn to translate these differences in intensity and in phase into terms of localization at the right or left of the body. If our own positions in space were fixed, if we could not turn our heads or move our bodies, we should only be able to tell when a sound was at the right or at the left. We could get no information about whether it came from above or below, from the front or from the rear. But by moving our heads in various ways we are able to vary the sound effects so as to receive a very complex system of cues by which the direction of the sound-waves can be judged. Children learn to do this very early in life. Before the end of the first year the infant will promptly turn toward the unseen source of a sound or cock his head this way and that in attention to a faint or unusual sound. Through repeated experiences of this kind the art of localizing sounds is learned.

Like the eye, the ear accomplishes most of its growth before birth. This is particularly true of the parts of the

ear that lie inside the head. The shell-like structure on the outside is not an essential part of the ear but only an accessory that in many animals is useful for collecting and directing the sound-waves inward toward the real hearing apparatus. In man the external ear has lost most of its usefulness except as a partial protection from dirt and insects.

Within the head are the real organs of hearing. Extending inward from the external ear is the canal leading to them. In the adult, this canal is a little more than one inch in length. Across the inner boundary of the canal is stretched a membrane known as the *tympanic membrane* or ear-drum. When the sound-waves reach this membrane they cause it to vibrate, and this vibration is passed on to the nerve-cells in the inner ear by means of a chain of three little bones known as the *ossicles* that are hung across the middle ear in such a way that the vibration is concentrated upon a small opening between the middle and inner ears. (See Figure 18.) The inner ear is filled with a salty fluid, and this fluid is set in vibration by the vibration of the ossicles.

The inner ear contains, besides the special apparatus for hearing, the apparatus for the sense of static equilibrium or, as it is sometimes called, the sense of head-position. This apparatus consists of three semicircular canals lying nearer the outside of the head and somewhat higher up than the part of the inner ear in which the sense-cells for hearing are located. As can be seen in Figure 19, these canals lie in three different planes, corresponding to the three plane surfaces that make up a solid right angle like that on the corner of a cube. In addition to the canals there is a rounded cavity called the *vestibule* from which the canals open. Both the vestibule and the canals are filled with fluid and are equipped with receptor cells that end in fine hairs sticking up into the fluid. When the head is turned in any direction the hairs bend and the fine sensory nerve-endings that lie at their

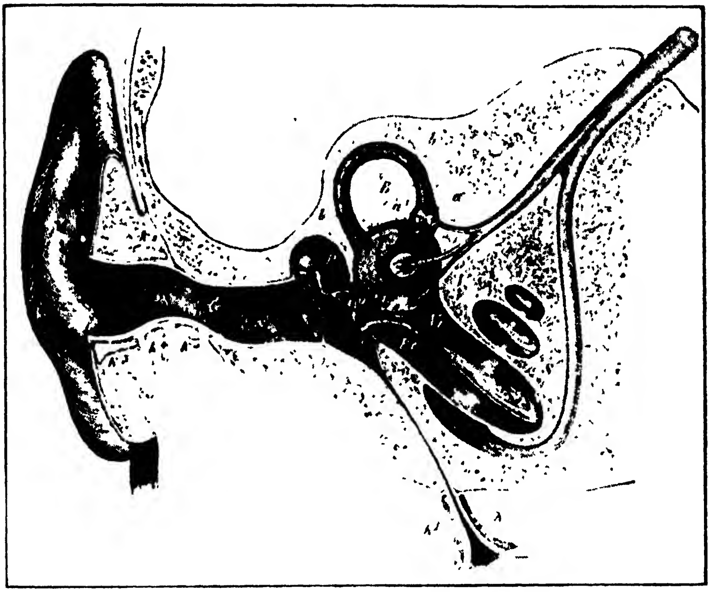


FIGURE 18

SEMIDIAGRAMMATIC SECTION THROUGH THE RIGHT EAR

P, ossicles; *B*, semicircular canal, *l*, vestibule; *Vt*, *Pt*, cochlea. Note that the vestibular branch of the auditory nerve leading off from the semicircular canals and vestibule, which are the organs for the sense of static equilibrium, is entirely distinct from the auditory branch running out from the spiral-shaped cochlea or organ of hearing

(From Martin's *Human Body*. Courtesy of Henry Holt and Company.)

bases are stimulated. The fact that the canals lie in three different planes means that it is impossible to move the head even slightly in any direction without setting up a flow of liquid in one canal or another, and thus stimulating the nerve-cells. Sensations of this kind are rendered even more acute by reason of the fact that in the vestibule, which is really a part of each of the canals since all open into it at each end, there are entangled in the ends of the hairs little particles of mineral matter called *otoliths,* the purpose of

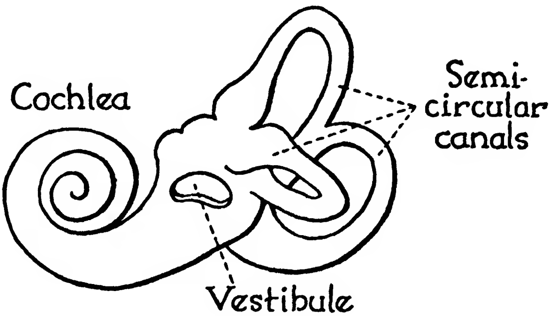


FIGURE 19

A SECOND VIEW OF THE INNER EAR, SHOWING ARRANGEMENT OF THE SEMI-CIRCULAR CANALS AND THE COCHLEA

which seems to be that of weighting the hairs so that their bending will stimulate the sensory nerve-endings more strongly.

In back of the semicircular canals the vestibule rolls up into a spiral, shaped much like a snail-shell and named from the Latin word *cochlea,* meaning "snail." Within the cochlea is a narrow membrane extending throughout its length, the *basilar membrane.* The membrane contains many thousands of fibers running across it. At one end the membrane is comparatively narrow and the fibers are short and very tightly stretched; at the other end, where the membrane widens out, they are longer and less taut. On the basilar

membrane the sense cells or receptors for hearing are located. They are hair-cells, with the sensory nerve-endings twined about their bases.

The inner ear, including (1) the organs of hearing within the cochlea and (2) the vestibule and canals that are the organs for the sense of equilibrium, develops from ectodermal cells (that is, cells on the surface of the body) lying just at each side of the neural crest. Thus, although these sense-organs were not originally a part of the nervous system as is the case with the eye, they are closely related to it in origin and like it they are precocious in growth as compared to the rest of the body. In early embryonic life the external ear with the opening of the auditory canal lies well down on the throat, as shown in Figure 7B. Its change in relative position later on is due to the growth of the lower part of the face.

Theories of Hearing

Although both the physical properties of sound and the general structure of the inner ear, which is the receiving instrument for the sound-waves, have long been known, the exact manner in which the auditory mechanism works is still a matter of controversy. The question to be answered is how the special qualities of sound such as pitch, intensity, and timbre are perceived and recognized. Several theories have been proposed, of which the *resonance theory*, first outlined by Helmholz * and later modified by Forbes and Gregg,† and the *telephone theory*, which has been most explicitly described by Boring,‡ are the most important.

According to the resonance theory the basilar membrane

* H. Helmholz, *Sensations of Tone*, translation by Ellis (London: Longmans, Green & Co., 1875).

† A. Forbes and A. Gregg, "Electrical Responses in Mammalian Reflexes. II. The Correlation between Strength of Stimuli and the Direct and Reflex Nerve Responses," *Amer. J. Physiol.*, 1915, 39: 172-235, especially p. 229.

‡ E. G. Boring, "Auditory Theory with Special Reference to Intensity Volume and Localization," *Amer. J. Psychol.*, 1926, 37: 157-188.

acts as a series of resonators, something like the strings of a piano. When the fluid in the inner ear is set in vibration, the fibers of the basilar membrane that are tuned to that particular vibration rate also vibrate, just as the strings of a piano will do when a tone of constant pitch is sounded near them. The varying length of the fibers in the basilar membrane makes them capable of responding to sound-waves of different rates. The long, slack fibers respond to slow vibrations, from which we have the sensation of tones that are low in pitch; the short, taut fibers respond to the more rapid vibrations and give the sensation of high tones. The hair-cells that are located on these fibers are stimulated by their vibration and the nerve-impulse thus aroused reaches the brain over the corresponding fibers of the auditory nerve. According to the resonance theory, therefore, differences in pitch depend upon the stimulation of different receptors in the inner ear. Intensity or loudness depends either upon the spread of response upon the basilar membrane, involving the excitation of more fibers at one time, or upon a greater amplitude of vibration in the membrane with a consequent increased frequency of response in the nerve-fibers concerned or upon both these factors acting in combination.

Certain objections to the resonance theory have been raised. In the first place, the longest fibers of the basilar membrane are only about three times the length of the shortest ones, and this difference does not appear to be great enough to take care of the extreme differences in pitch that we hear. However, since tension as well as length affects the sympathetic response of the fibers, this point may perhaps be answered. A second objection has to do with the fact that when the stimulation is vigorous not merely a single fiber but a band of fibers will respond. This might be expected to give rise to a blurred or impure tone sensation, but as a matter of fact even rather loud tones may seem to the observer to be psychologically "pure" as far as funda-

mental pitch is concerned. Gray * answers this objection by stating that the pitch of a tone depends upon that part of the membrane in which the vibration is strongest.

One of the strongest lines of support for the resonance theory comes from certain experiments carried out with guinea-pigs. These animals were subjected to stimulation by sounds of constant pitch for several weeks without cessation. Eventually they became totally deaf to these pitches. Post-mortem examination showed that the hair-cells on the basilar membrane had degenerated in the region in which the resonance theory would lead one to expect the degeneration to occur. Animals that had been made deaf to high pitches showed degeneration of the cells on the short fibers; those deafened to low pitches showed degeneration of cells on the long fibers. The remaining cells were unaffected.

The chief rival of the resonance theory is known as the *telephone theory*. The resonance theory makes pitch discrimination a matter of the particular fibers of the basilar membrane that are aroused to sympathetic vibration by sound-waves of differing frequencies and hence of the particular nerve-fibers over which the action currents reach the brain. The telephone theory, on the other hand, assumes that sound-waves of different frequencies give rise to nerve impulses of corresponding frequencies in the nerve-fibers themselves and that these differing frequencies are analyzed within the central nervous system as differences in pitch. Intensity or loudness, according to this theory, depends upon the number of fibers involved.

The most serious objection to the telephone theory is to be found in the fact that in order to account for the high pitches the auditory nerve would have to respond at least as rapidly as 20,000 times per second, which is about twenty times as fast as experiments on the rapidity of nerve-im-

* A. A. Gray, "On a Modification of the Helmholz Theory of Hearing," *J. Anat. and Physiol.*, 1900, 34: 324-350.

pulse have found to be typical. It is known that whenever an impulse or "wave" passes over a nerve-fiber, a period follows during which further stimulation is impossible. This period is known as the *refractory phase* in nerve conduction. The duration of the refractory phase varies in different nerves, but most determinations for sensory nerve-fibers have been of about the order of a thousandth of a second. However, an ingenious experiment carried out by Wever and Bray * shows that the vibration pattern of the physical sound-waves must be reproduced within the auditory nerve, although not necessarily within each individual fiber of the nerve. In this experiment the action currents † in the auditory nerve of a cat were led off through an amplifying device to a telephone receiver. When tones were sounded before the cat's ear, it was possible for an observer in another room to compare the sounds that came to him by way of the auditory apparatus of the cat with those heard by his own ears in the ordinary manner. The two were indistinguishable. Differences in pitch, in intensity, and in tonal quality or timbre all were reproduced exactly. Even speech could be heard and understood. This means that in some way the atmospheric waves that form the basis for direct hearing must be reproduced in all their essential characteristics in the action current of the nerve itself.

This experiment appears to indicate that neither of the foregoing theories can be accepted without modification. Wever and Bray suggest a number of alternatives, of which the following, to which they give the name of the *resonance-volley theory,* is an example. This theory involves some of the principles of both the resonance and the telephone

* E. G. Wever and C. W. Bray, "Action Currents in the Auditory Nerve in Response to Acoustical Stimulation," *Proc. Nat. Acad Sci.*, 1930, 16: 344-350; "Present Possibilities for Auditory Theory," *Psychol. Rev.*, 1930, 37: 365-380.

† The term *action current* refers to a change in the electrical potential of the nerve which accompanies the nerve impulse.

theories, with an additional factor known as the "volley principle." Like the simple resonance theory, the resonance-volley theory assumes that sensations of pitch result from the stimulation of particular sense-cells on the basilar membrane: in other words, that the basis for pitch discrimination is in the ear. In common with the telephone theory it assumes that the action currents within the nerve have the same temporal frequency as the sound-waves by which they are occasioned. Unlike the simple telephone theory, however, it postulates that the impulses within the individual nerve-fibers are no more rapid than those of other sensory nerves and that the very high frequency necessary to duplicate the physical sound-waves is brought about by the combined action of several nerve-fibers with differing refractory periods acting in synchronization with each other and with the physical stimulus. This hypothesis is the foundation of the volley principle just mentioned. A schematic representation of the volley principle is shown in Figure 20.

When a given nerve-fiber is stimulated by the bending of its hair cell, it responds and then remains inactive for the length of its refractory period. It then responds again to the next stimulation from the hair cell and so on. Its responses are thus timed to the vibrations of the basilar membrane, but instead of responding to every one of the vibrations of the latter it responds only to every third or fifth or tenth vibration, depending on the length of its refractory phase. Now if we assume that the different fibers making up the auditory nerve have refractory periods of somewhat differing length, we may regard the action current in the entire nerve as being made up of a volley of these responses from the separate nerve-fibers occurring at different rates but all timed to the same basic vibration pattern, which is that of the physical stimulus. You are familiar with the way a drummer doubles the speed of his drum-beats by using the

two hands in alternation. Imagine a number of drummers each employing the same basic rhythm but alternating his beats with those of his companions. By increasing the number of drummers it is possible to increase the speed of the beats up to any desired frequency.

The wavy line at the top of Figure 20 represents the frequency of the sound-waves at a given pitch and in-

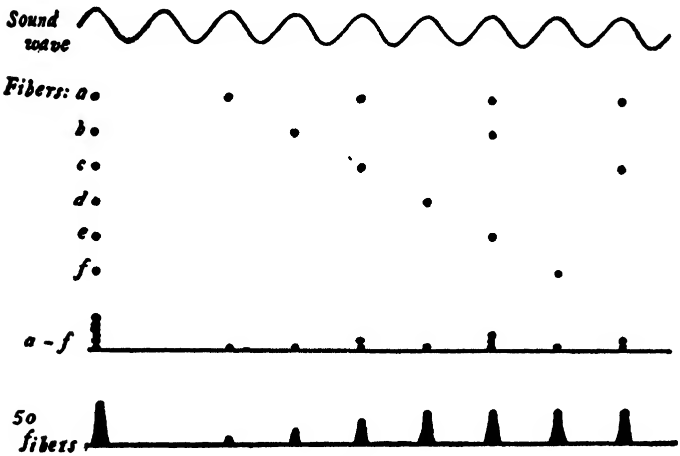


FIGURE 20

THE VOLLEY THEORY OF HEARING

(From E. G. Wever and C. W. Bray, "Present Possibilities for Auditory Theory," *Psychol. Rev.*, 1930, 37: 365-380. Courtesy of Psychological Review Co.)

tensity. The fibers of the basilar membrane which are attuned to this pitch are thrown into sympathetic vibration at the same rate as the sound-waves, and the hair-cells situated on them are stimulated at every vibration of the basilar fibers. All this is in accordance with the simple resonance theory. Likewise, the nerve-fibers (indicated in the diagram by the letters *a*, *b*, *c*, *d*, *e*, and *f*) also respond in every instance to the *first* stimulation from the hair-cells.

But the second stimulation of the hair-cells finds most or all of the nerve fibers leading out from them in the refractory phase and so it has no effect. Fiber *a*, however, which has the shortest refractory phase, is ready to respond again to the third stimulation, and to every alternate stimulation

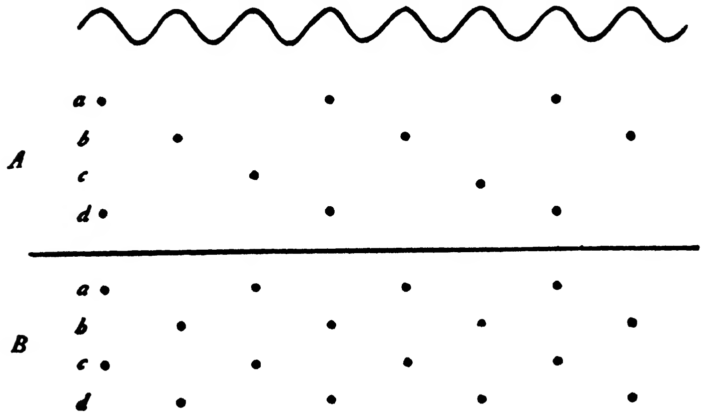


FIGURE 21

INTENSITY ACCORDING TO THE VOLLEY THEORY

A represents a tone at a given intensity, with four fibers, *a*, *b*, *c*, *d*, responding; *B* represents the same tone at a higher intensity, with the fibers responding at a higher rate. The exciting frequency is represented in each case, but in *B* with a greater total number of impulses.

(From E. G. Wever and C. W. Bray, "Present Possibilities for Auditory Theory," *Psychol. Rev.*, 1930, 37: 365-380. Courtesy of Psychological Review Co.)

thereafter. Fiber *b*, with a slightly longer refractory phase, comes in on the first, fourth, and seventh stimulations, etc. Fiber *c*, with a still longer refractory phase, enters the volley on the first, fifth, and ninth stimulations. And so on with the others, according to their rate of recovery in the refractory phase.

Figure 21 illustrates the resonance-volley explanation of differences in intensity. By increasing the strength of a stimulus (in this case, the loudness of the sound) the re-

fractory periods of the nerve-fibers can be shortened. Shortening the refractory periods means that the separate nerve-fibers enter the volley at shorter intervals and the total number of impulses in the nerve as a whole is thereby increased. With increasing loudness of sound, additional fibers with higher thresholds may also enter the volley, thus further increasing the total frequency. According to this assumption, intensity depends upon the total frequency of impulse within the auditory nerve.

Although the exact manner in which we hear is still uncertain, most investigators appear to favor some form of the resonance theory. The resonance-volley theory is an attempt to bring the results of recent experimental work into line with this theory and to answer some of the objections that have been made to it while retaining its most significant features. While we must not forget that it is still a theory rather than an established fact, it at least affords a reasonable working basis for explaining the facts of hearing as they are known to us to-day.

Possibilities for Sensory Experience During Prenatal Life

Although the sense-organs reach a level of development at which they are able to function, in some degree at least, considerably before birth, the external conditions necessary to arouse them to action are for the most part lacking. There is no light to stimulate the retina, hence there can be no sight; the ear is so protected from sound-waves by the surrounding tissues of the mother's body that hearing can function very little.* Any stimulation of the olfactory organs or of

* The fetus does respond to loud sounds before birth. This has been shown by placing instruments on the body of the mother by means of which fetal movements are recorded on a revolving drum. When a loud clanging noise is made near the mother's abdomen, responsive movements of the fetus take place. Only loud sounds, however, will arouse the reaction.

the taste-buds must be of so constant a nature that the baby would be too accustomed to it from the start to respond, just as we do not "taste" our own saliva when the mouth is in a healthy condition. The temperature is too constant to stimulate either of the temperature senses, and there is not likely to be anything to cause real pain. This leaves as further possibilities only the tactile sense, which cannot be stimulated in any wide variety of different ways as long as the child remains in the uterus; the organic sensations, which are never very exact or well localized even in the adult, and which would be expected to function very little before the digestive organs begin to operate after birth; the sensations of bodily posture that are obtained from the proprioceptors in the muscles and joints; and possibly the sense of bodily equilibrium or head-posture that is derived from the vestibule and the semicircular canals in the ear.

However, the centers in the cerebellum for the reception of posture sensations do not become well developed until some time after birth. Moreover, since the receiving instruments alone, without the transforming mechanism in the central nervous system, would be worthless, even the existence of posture sensations is to be questioned.

It is very doubtful, therefore, whether anything resembling adult consciousness as we know it can be experienced by the fetus, though it is possible that there may be vague feelings of comfort or discomfort that may perhaps serve as the immediate stimuli for the writhings and twistings so clearly perceptible to the mother during the later months of fetal life. On the other hand, such movements may unquestionably occur without any awareness whatever on the part of the fetus, just as we ourselves turn and toss about during sleep without knowing anything about it. If we compare the amount of time spent in sleep by children of younger and younger ages until we get back to the time of

birth, and then "project" the curve of sleep back into the fetal period, the result makes it seem probable that during prenatal life practically all the time must be spent in sleep or in a condition closely resembling it. This assumption is further borne out by observation of the behavior of infants prematurely born who, if they are healthy, sleep almost continuously up to about the age of normal birth. A child born eight weeks ahead of schedule whom I had opportunity to observe almost always had to be awakened for feeding, and even then it often took the combined efforts of mother and nurse to keep her awake long enough to take the necessary amount of food. Although the feeding difficulty became less after the first two or three weeks, she continued to sleep nearly all the time until full term.

A few psychologists belonging to what is known as the psychoanalytic school lay great stress upon the prenatal period as a time of absolute peace, contentment, and joy—a sort of Nirvana-like existence, the memory of which persists in the "unconscious" mind even into adult life. According to them, this submerged or unconscious memory betrays itself in a constant inner urge to return to the former state of protected bliss, an urge that becomes increasingly powerful when the conditions of life are hard or unpleasant. Ordinarily this desire is kept so well under control that the individual himself may remain unaware of it; but, if conditions become too hard, the mental and emotional strain too great to be borne, then the control snaps, the repressed desire becomes the ruling force, and the individual "regresses" to a state that imitates the prenatal condition as closely as possible. Most of his time is passed in sleep or in a condition that resembles sleep, control over the bodily functions disappears, frequently the prenatal posture is assumed (see Figure 7C), and the patient has to be fed and cared for like a new-born child.

Although conditions such as have been described do

appear in certain forms of mental disease,* it is a far cry indeed from observing such behavior to the assumption that it is due to any sort of unconscious memory of the prenatal state or desire to return to it. As we all know, with the passage of time forgetting proceeds rapidly. Forgetting is particularly rapid when the events or conditions in question are not clearly sensed at the time of occurrence. We all know how quickly dreams disappear from memory and how soon we lose all recollection of events which, although they may have occurred in our presence, did not particularly attract our attention. The question of prenatal consciousness is at best highly speculative. The likelihood of securing any valid information concerning it appears to lie so far in the future that attempts to base any far-reaching theories upon its existence or its nature are unwarranted.

* See Chapter XXV.

Chapter VI

THE BEHAVIOR OF THE UNBORN CHILD

From what sources has our knowledge of fetal activity been gained?

Is all muscular activity aroused by nerve action?

At about what age does the human heart begin to beat, and what starts it in motion?

What kind of movements does the young fetus make in response to stimulation of the skin? How would you characterize the changes in behavior that take place as the fetus grows older?

Does the brain or the spinal cord play a greater part in controlling fetal behavior?

Sources of Information on Fetal Activity

The human fetus begins to make bodily movements that can be perceived by the mother at about the middle of the prenatal period or slightly earlier. But the maternal sensations are not exact enough to tell us much about the kind of movements that are being made. When the mothers are questioned, about all they can say is that the first perceptible sensations usually feel like a "flutter" and that as time passes the movements become stronger and take on the character of wriggling, twisting, squirming, and kicking. These descriptions are undoubtedly influenced in part by the mother's knowledge of what babies do after they are born. Upon one point, however, there is very general agreement. The older the fetus, the more frequent and vigorous are its movements. Examination of fetuses prematurely born has shown that movements occur at a much earlier date

than that at which they first become perceptible to the mother.

Our most valuable information about fetal behavior has been obtained from two sources, observation of the behavior of human fetuses born at various stages of prematurity, including many too young to survive more than a few hours or even minutes, and observation and experiment with fetal animals artificially delivered. Although we cannot be sure that the developmental stages in animal behavior run exactly parallel to the corresponding stages in human behavior during the prenatal period, certain general principles have been noted that seem to apply to both. Some of the most important of these principles will be described in the sections that follow.

Idio-Excitability of Muscles

The first detectable movement either in the human or the animal embryo is the beating of the heart. In the chick this has been observed as early as the second day of incubation, before anything that looks like a chicken can be seen in the egg. In the human embryo the heart begins to beat at about the third prenatal week. You can easily see why this is necessary, for the fetus has its own circulatory system from the beginning, and if food and oxygen were not carried by the blood to all parts of the growing organism the processes of growth and of waste and repair of tissues could not go on.

There is fairly good evidence that the beating of the heart begins independently of neuron action; probably it starts before the outgrowing axons have reached the heart. Even during the early stages of development, it has been found possible to stimulate muscle tissue directly and so to cause it to contract without nerve action. Hooker,* for example,

* Davenport Hooker, "The Development and Function of Voluntary and Cardiac Muscle in Embryos without Nerves," *J. Exper. Zoöl.*, 1911, 11: 159-186.

found that when frog embryos were operated on in such a way that all connection between the neural tube and the muscles was severed at a very early stage of development when the axons had not yet begun to form, the muscles would continue to develop, but except for the heart there was no spontaneous movement. The heart, however, began to beat at about the same time in the frogs without nerves as in normal animals. Mechanical stimulation of the skin with the point of a stiff hair would induce movement in the voluntary muscles * of the normal animals but not in those without nerves. If, however, a very fine needle that would penetrate the skin was used, the muscles would contract; but the contraction was limited to a much smaller area in the operated animals than in the normal ones. Electrical stimulation of the muscles also brought about contraction. Hooker sums up his findings as follows: "Cardiac muscle, which we have reason to believe is the most primitive, will function spontaneously and rhythmically without nervous control. The axial muscles, on the other hand, will not function spontaneously in the absence of the nervous system, though they will respond to direct stimulation."

In this primitive excitability of the muscles we have a device, not so much for organizing and coördinating the different parts of the body with each other as for providing a certain crude protective mechanism for local parts at a stage of development when neuron action is as yet imperfectly organized. The contraction of the muscles in the operated animals was always confined to the part stimulated, and it always resulted in withdrawal of the stimu

* The *voluntary muscles* are those that we are able to move at will, such as the muscles of the arm and legs, as opposed to the *involuntary muscles* of the viscera, which are not under our control. The voluntary muscles are made up of fibers that run parallel to each other, giving them a striped appearance; hence they are known as *striate muscles*. Most of the involuntary muscles are made up of extremely fine fibers that run in all directions like a fine web. They are known as *smooth muscles*. The heart, however, is modified striate muscle.

lated part a little further away from the point of stimulation. But the body as a whole did not move, showing that the idio-excitability of the muscles does not serve to keep the parts of the body in communication with each other. It is not an integrating device like the nervous system but serves only a local function. Moreover, although this capacity of muscle tissue to respond to direct stimulation does not disappear even in adult life, its chief usefulness is temporary. Even heart action is soon brought under the control of the nervous system.*

Muscular Activity Arising from Nerve Activity

In normal animals a form of behavior soon appears that is in many ways very different from the simple localized contractions of small groups of muscle cells that can be aroused by direct stimulation of the muscles. This later behavior is aroused and controlled by the nervous system through its receptors, which were described in the last chapter, and its effectors, which are finely branched endings of the motor neurons that terminate in the muscles and glands and through which the action currents in the nerves are passed on to the muscles, causing them to contract. The chief differences between idiomuscular activity and neuromuscular activity are these: (1) Idiomuscular activity is confined to the particular region stimulated, while neuromuscular activity may display itself in any part of the body. Thus, the response to a visual stimulus, say the sight of an angry bull, may arouse a vigorous muscular response in the whole body and particularly in the feet and legs, which are as far removed from the stimulated region (the eyes) as the size of the organism permits; (2) except for the heart,

* This is true at least to the extent that the heart will be made to beat more rapidly by direct action of the nervous system. Whether the normal heart rhythm is *neurogenic* (having its origin in the nervous system) or *myogenic* (having its origin in the muscle tissue) is still a matter of controversy.

idiomuscular activity does not appear to occur without direct external stimulation, whereas neuromuscular behavior may arise from such internal activities as thoughts or desires. Thus both the stimulus and the response in idiomuscular activity must be highly localized, whereas in neuromuscular activity the stimulus, the response, or both may be either generalized or localized within a particular area. Practically all postnatal activity is neuromuscular.

In the early behavior of the fetus, however, whether it be animal or human, generalized rather than local responses are characteristic of neuromuscular activity. It was formerly supposed that complex forms of behavior came into being by little bits which developed separately and later became chained together to form the whole act. But recent studies have shown that this "chain reflex theory," as it was called, has little to support it. Instead of the independent development of the separate parts of an act which are later linked together into a whole, the mass movements appear first and the finer movements develop out of them. We may liken it to the growth of a tree. First there is the main shoot. As it grows, offshoots or branches arise; as these grow, smaller branches proceed from them. So in the development of behavior during the fetal period, movements of the trunk precede movements of the limbs; movements of the arms and legs precede independent movements of the fingers and toes, and so on. There seems, moreover, to be a tendency for movements of the upper parts of the body to precede those of the lower parts, just as in physical growth the head portions of the body are precocious in development as compared to the legs.

Coghill,* who has made very extensive studies of the development of *Amblystoma* (the common salamander), has shown that the progressive development of behavior is

* G. E. Coghill, *Anatomy and the Problems of Behavior* (Cambridge: The University Press, 1929).

paralleled to a remarkable degree by the growth and development of the neural mechanisms that keep the parts of the body subordinate to the whole. By the use of motion-pictures he was able to make permanent records of the behavior shown by an animal at any given stage of development and then, by means of post-mortem examination, to determine the degree of neurological development corresponding to that stage. He found that the first spontaneous movement that can be detected is a simple coil of the trunk, which later develops into a double coiling movement something like the letter S, from which the swimming movements are derived. (See Figure 22.) Later still the limbs participate, the fore limbs first and later the hind limbs. In the case of salamanders that become able to live either in water or on land, the walking movements develop directly out of the swimming movements that were displayed at an earlier stage of development. Walking is a more advanced stage in the sequence than swimming, however, because in walking the leg movements, which represent a comparatively advanced stage in development, play a much more important part than they do in swimming, which is performed in large measure by the alternating double flexion of the trunk. Coghill has shown that the growth of these behavior patterns is always a matter of the total organism, that they are tied together from the start and do not develop as small units that later become coördinated with each other. The whole is not built up from its parts, but the parts develop out of the whole.

The explanation for this, in Coghill's opinion, is to be found in the precocious growth of the neural structure. By studying the nerve development of animals at different stages of behavior, he was able to show that the growth of the nerve-fibers outward to the muscles or, more exactly speaking, to the region where the muscles are being formed, precedes the actual differentiation of the tissues into true

muscle-cells. The growth and differentiation of nerve and muscle proceed simultaneously, but the neural growth keeps

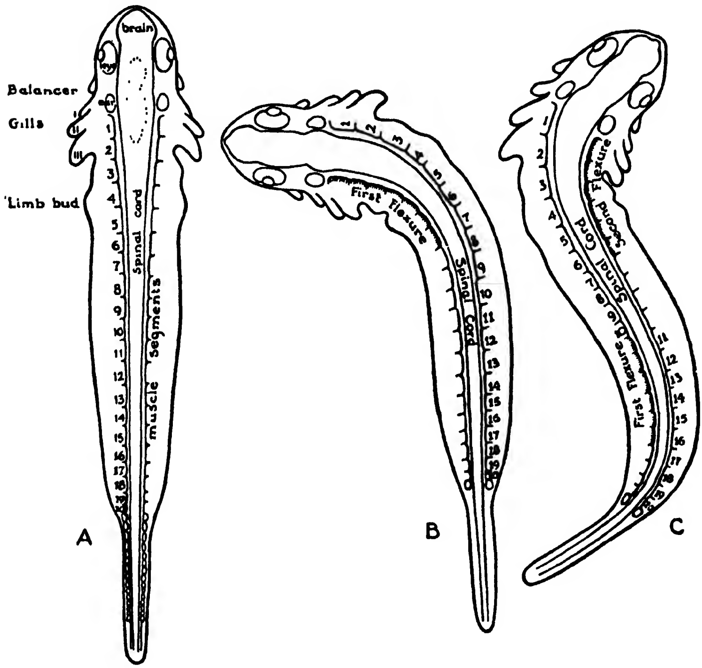


FIGURE 22

DEVELOPMENT OF SWIMMING MOVEMENTS IN AMBLYSTOMA

From the resting position (A) a flexure (B) begins in the head region and proceeds tailward as if, according to its earlier habits, the animal were going to throw itself into a tight coil; but instead of doing this it reverses the flexure in the anterior part before the first flexure has passed through the entire length of the animal. There are now two flexures in progress at the same time, one to the right and the other to the left, both of them progressing from the head tailward (C).
(From *Anatomy and the Problems of Behavior* by G. E. Coghill. Courtesy of Cambridge, University Press.)

safely in advance of the muscle growth. "As a result of this precocious invasion of limb-forming tissue by branches of nerve-cells that are already integrating the trunk, the earli-

est movements of the limbs are of necessity totally integrated with trunk action." *

Working with cats, Windle and Griffin † found that much the same type of sequence holds. The earliest movement that could be seen was a flexion of the head and upper trunk. At later stages the movements had progressed to include first the lower trunk, then the limbs, the tail, and the toes, and still later the finer muscles of the face, throat, and tongue. Here again we see that the earliest movements are mass movements and not movements of local parts, and that the order of functional development, like the order of physical growth, proceeds from the head downward and outward to the limbs.

Minkowski ‡ has made the most extensive investigations on the behavior of the human fetus that have appeared to date. As in the case of animals, he finds that mass activity appears first and local activity second, and that the development of behavior is closely paralleled by the growth and development of the nervous system. But the nervous development is primary, the behavior secondary. The one closely follows the other.

The fetuses studied by Minkowski were all artificially delivered by Cæsarian section because of some special condition in the mother which made it unsafe to allow the pregnancy to continue. Their ages ranged from two to five months. Because of the way they were delivered, there was no question of birth injury, which often makes it hard to interpret the earliest forms of behavior shown by infants born in the usual way, as we shall see in the following chapter.

* Coghill, *op. cit.*, p. 22.

† W. F. Windle and A. M. Griffin, "Observations on Embryonic and Fetal Movements of the Cat," *J. Comp. Neurol.*, 1930, 52: 149-188.

‡ M. Minkowski, "Über frühezeitige Bewegungen, Reflexe, und muskulare Reactionen bei menschlichen Foetus, und ihre Beziehungen zum foetalen Nerven und Muskelsystem," *Schweiz. med. Woch.*, 1922, 3: 721-724, 751-755.

The tiniest ones, those only about three inches in length whose age was estimated at about two to three months, made only slow, uncoördinated, and non-rhythmical movements which were not confined to the part of the body that was stimulated but might affect almost any part. For example, "a light pressure on one foot or often merely a stroke of the foot with a small camel's hair brush would cause not only a withdrawal or some other movement of the stimulated leg but also various reactions in the opposite leg (bending, stretching, etc.) and in both arms (as for example, bending and afterward stretching or twisting or bringing both arms forward). Movements of the head and body might also occur. . . . *One might say, therefore, that every section of the skin can serve as a reflex zone for extremely variable reactions which have a tendency to spread out, more or less, over the entire fetal organism.*" *

With the older fetuses, however, especially those from seven to ten inches long whose age was estimated at four to five months, the responses to stimulation were sometimes confined to the part of the body that was stimulated, "yet there remained a tendency for the movement to spread to the other extremities and to the whole body in most instances. In one fetus of 19 cm. [about seven and a half inches] a diagonal reflex was observed in which a stimulation of one foot in the same constant manner always aroused a movement in the opposite hand. . . . In a few fetuses of 11 to 21 cm. [about four and a half to eight and a quarter inches] a touch on the upper lip or on the tongue produced movements of opening and closing the mouth as in the beginning of suckling."

Minkowski also found evidence of idiomuscular activity which differed from neuromuscular activity in the same way as was shown by Hooker's frog embryos. Separation of the brain from the rest of the body made very little difference

* Italics are Minkowski's.

in behavior, showing that most of these early reflexes are under the control of the spinal cord rather than the brain.

General Summary of Prenatal Development

The development of behavior in the unborn child or animal, like the development of the body itself, follows an orderly course. The mass movements of the young fetus, in which the body moves as a whole and there are few or no independent movements of local parts, become gradually differentiated into movements that show the beginnings of adaptation to the particular stimulus employed or to the part of the body that is stimulated. At first only generalized movements can be made. This is true of the human fetus as well as of animals. The very young fetus of the salamander can do nothing but coil when he is touched; if he moves at all, that will be his reaction. The unborn kitten at a corresponding level of development will make a squirming movement chiefly of the head and upper part of the trunk. The first reactions of the human fetus are much like those of the cat, and as with the cat and the salamander, the child's behavior at the beginning is not well adapted to the stimulus that calls it forth. A touch on any part of the body may arouse movement in almost any other part. Fairly early in the fetal period, however, the movements of the local parts begin to acquire some degree of independence. Local reflexes appear in which stimulation of one part of the body no longer brings about a movement of the whole, or, at least, in which the mass movements are much reduced. A touch on the lips brings out the suckling reaction as the major response, usually accompanied, it is true, by some general bodily squirming which shows that the act of suckling is not yet completely freed from the mass movements out of which it developed. Stimulation of one part of the body becomes increasingly likely to elicit more pronounced movements of that part than of others, and thus behavior

becomes adapted to particular needs and excess movements are eliminated.

Behavior patterns thus appear to follow the same general course of development as the development of the physical organism in that the course of growth is from the general to the specific, from the whole to the parts. Moreover, just as the head regions of the animal and particularly of man are more precocious in their growth than the other parts of the body (see Figure 9, p. 69), so there appears to be a tendency for body movements to appear first in the upper regions of the trunk and from there to spread downward and outward to the limbs. In physical growth, this is known as the *law of anterior-posterior development.* In its general aspects at least, it seems to hold good for certain kinds of behavior as well.

This gradual spread of reaction with its accompaniment of increasing independence of local parts has been shown to follow upon corresponding changes in the nervous system. The major nervous pathways are laid down first, the local pathways later. And from the very beginning, the growth of the brain and particularly of the cerebral part of the brain keeps far in advance of the growth of the remainder of the body. This tendency for brain growth to run ahead of general bodily growth is far greater in man than in other animals. In general it may be said that the greater the intelligence of the animal the more precocious is the growth of the brain and particularly of the cerebral hemispheres. It is not only that in the more intelligent animals the cerebrum tends to be larger (in proportion to body weight) than it is in the less intelligent, but the excess growth occurs at an earlier stage of development. Coghill,* after citing certain examples, makes the following comment: "In man at a stage of development when bodily movements are of the simplest order, that part of the mechanism of associa-

* *Op. cit.*, pp. 92-93.

tion which deals particularly with the highest mental and moral processes not only is relatively massive but has definitely begun to organize itself into the mechanical pattern that characterizes it in the adult. . . . The greater the possibility of behavior in the animal, the more the cerebral conditioning mechanisms run ahead of the motor or effector mechanisms in development."

We have stressed the importance of the prenatal period in development because it is important for the student to realize from the start that from the earliest to the latest stage of development both mental and physical growth follow an orderly course which is determined by the interaction of the inborn qualities of the cell tissue and the environment in which the cells find themselves. As a result of this interaction the parts of the body are differentiated from each other, and in this differentiation the nervous system takes the lead. By the time of birth all the main parts of the nervous system have been laid down, the sense-organs are able to function, and the child, who has until then lived a protected life within the body of the mother, is ready to adapt itself to a new world of ever-changing conditions. Up to then he has had little to do but grow. Food and oxygen have come to him regularly from his mother, he has not been bothered with indigestion because he has had nothing to digest for himself; he has not known cold or excessive heat, or the restraint of clothing. At birth all this is changed. For the first time he begins to breathe, eat, digest for himself; for the first time he is subjected to a varying temperature to which his body must adjust as his sense-organs begin to react to outside stimulation. He tastes, smells, perhaps hears a little, sees but without understanding. A tremendous change, this, yet the preparation for it has been so perfectly made that both physical growth and mental development continue their normal course with only a brief period of adjustment. Before going on with an

account of his growth and development after birth, it is well to pause long enough to examine the new-born baby with some care, to try out a few experiments with him, to look into the matter of his abilities and talents, his weaknesses and defects, his ability to learn. In the next chapter, therefore, we shall attempt to make a brief survey of the mental traits of the new-born child, of his equipment for meeting the many demands of the new and varied environment into which he has so suddenly been thrust.

Chapter VII

THE CHILD AT BIRTH

Can we tell whether a particular baby is going to be bright or dull by watching his behavior during the first week of life?

In what way do the characteristic responses of the new-born infant to stimulation of some local part of the body differ from those of the older child or the adult?

Can the new-born baby see form? color? Can he hear? smell? taste? Can he feel cold? warmth? touch? pain? Is there any difference between the kind of information the infant receives through his sense-organs and that which an adult would get from the same situation?

When and how does the baby begin his learning?

Do we know what physiological changes in the nervous system occur in learning? What are some of the possibilities?

The Ordeal of Birth

The first two weeks after birth are best considered somewhat apart from the general course of development because of the unusual difficulties which must be met at that time. Not only must the child adjust to a change of environment greater than it will ever again meet, but it also has to recover from one of the most difficult and dangerous events of life. Although being born is not only a natural but a necessary part of every child's experience, it is not an easy one. For

hours he is subjected to dragging and pushing, to strong compression—particularly of the head, which at this age is the widest and most resistant part of the body. A fairly large percentage of all infants are artificially delivered. This means that in addition to the usual severe pressure, the child is forcibly dragged through the narrow passages of the mother's body by forceps clamped about its head. Even in modern civilized communities mortality statistics show that the hazards of the neonatal period are almost twice as great as those undergone by soldiers during the World War.

Considering the severity of the birth process, it is surprising how few children show any permanent effects of it. Although children's hospitals always include a few cases of paralysis or other difficulties attributed to birth injuries, the percentage is very small when compared to the number of infants whose heads are pressed out of shape or who suffer marked contusions, indentations of the skull, or other noticeable injuries at birth. Fortunately, even injuries that to the novice appear very severe rarely seem to exert any lasting damage upon the child's mental or physical growth.* The infant's remarkable power of recuperation from head injuries at birth is in part due to the softness of the skull bones at this age and to the leeway provided by the open fontanelles (popularly known as the "soft spots") at the top and sides of the head where calcification has not yet proceeded far enough to unite the bones of the skull completely.

Temporary effects of the birth experience are probably greater than most psychologists realize. It is likely that for

* This does not mean that birth injuries never leave permanent effects. Paralysis of different parts of the body as well as lasting mental defects sometimes result. One of our leading institutions for the feeble-minded reports that approximately 5-10 per cent of all its cases are attributable wholly or in part to injuries at birth. [E. A. Doll, W. M. Phelps and R. T. Melcher, *Mental Deficiency Due to Birth Injuries* (New York: The Macmillan Company, 1932).]

some hours at least the general mental and physical condition of the new-born child is analogous to that of an older person who has just undergone a major operation, and when labor is unduly difficult or prolonged or when forceps have been used, several days may elapse before recovery is complete. However normal may be the fact of birth, the new-born child is nevertheless not in a normal condition for some time thereafter.

For this reason it is unsafe to judge the abilities of an infant on the basis of his behavior immediately after birth. The length of time that must elapse before complete recovery from the minor injuries of a so-called "normal" birth will vary from child to child, but it is safe to say that for the first two or three days at least, and for a longer period when delivery has been unusually difficult, the fact that a child fails to show a given form of behavior must not be taken to mean that he would not be able to do so if his physical condition were normal. Accordingly, the fact that some babies, shortly after birth, are able to yawn, sneeze, bring their hands to their mouths and suck their fingers, raise their heads, and so on, is probably more significant than the fact that not all do so. Success means that the ability has been established; failure may be due to any one of a number of causes. It may be due to more than usually severe birth injury, to premature birth,* or to genuine backwardness. It is probable that the hope expressed by some psychologists that the time may come when the intelligence of the new-born may be tested as accurately as we are now

* Gesell, who has followed the early development of a number of premature infants, has been able to show that in most respects at least the behavior of the child who is prematurely born is retarded during infancy by about the extent of his prematurity. For example, the baby born two months ahead of schedule shows about the same level of mental and physical development at four months after birth as he would have reached at two months had he been born at the usual time. In reality, the child born two months early is a seven-months fetus and should be looked upon as a fetus rather than as a full-grown baby. Cf. Gesell's *Infancy and Human Growth*, Ch. XV.

able to test the ability of older children will not be realized for many years to come if at all. Certainly, until more accurate methods for determining the real age* of the new-born child and for measuring the extent of birth injury have been worked out, it is very unsafe to attempt to predict how a given child is likely to develop later on from his behavior during the first few days of life.

Adjusting to the New Environment

The first thing the child does upon entering the world is to cry. The significance of the "birth cry," as it is called, has been the subject of much solemn speculation on the part of certain philosophers. Kant interpreted it as a sign of wrath; Adler, as an indication of the child's sudden and overwhelming feeling of inferiority at being placed in so new and complex an environment. Unsympathetic bachelors have been heard to express the belief that the baby is merely giving the parents an early sample of what he can and will do later on! Physiologists, however, tell us that the birth cry is merely a reflex accompaniment of the first entrance of air into the lungs. It probably has no emotional significance whatever.

The physiological adjustment that the infant has to make during the first few days of extra-uterine life is very complicated. Evaporation of water from the tissues, together with imperfect nutrition while the new process of digestion is being established, results in a loss of weight during the first few days after birth. This loss usually amounts to several ounces, and it may be ten days or two weeks before the birth weight † is regained. With the taking-on of such

* By present methods, age at birth can be determined only within rough limits. The error of estimate may be two weeks or even more unless the date of conception is known.

† Weight at birth averages about seven pounds for girls and seven and a half pounds for boys. The usual length of the new-born infant is about nineteen inches.

new functions as breathing, eating, digesting, and assimilating, numerous changes occur in the internal organs and glands. Still other adjustments are required by the sudden change from a constant temperature of approximately 100° F. to one that is not only much lower on the average but varies within comparatively wide limits, and from uniform protection of all parts of the body to exposure of certain parts while the remainder is kept covered. There are also the new postures and the comparatively rigid means of support in place of resting in a fluid medium and shifting position only at the dictates of its own needs. All this has its psychological as well as its purely physiological aspect, and the adjustments required are not the less important because as yet their exact nature is uncertain.

For all these reasons, much caution must be observed in interpreting the results of experiments carried out with very young infants. Nevertheless, if the points that have been mentioned in the foregoing paragraphs are kept in mind, much that is of great importance may be learned from the study of the abilities shown by the infant as soon as the grosser effects of birth have worn off. Although growth and development have their beginning long before birth, most of the infant's learning may fairly be said to start at birth, since, no matter what his abilities may be, his opportunities for learning before birth are very limited. If we are to understand his later development, we must therefore try to get as clear an idea as possible of the initial equipment with which the new-born baby sets out to discover and explore the world about him.

The Behavior of the New-born *

Helpless as the new-born baby seems, he is nevertheless able to perform a rather large number of complicated acts.

* The term *new-born* as used here includes the first two weeks after birth unless exact ages are stated.

A B

FIGURE 23

THE GRASPING REFLEX

A Month old baby supporting weight by both hands

Many babies are able to do this at birth and frequently by the use of only one hand but as a rule the weight cannot be sustained in this way for more than a minute or two The reflex reaches its maximum strength about the fourth month, then wanes and later reappears as a voluntary act.

(Courtesy *Journal of Heredity.*)

B. New-born monkey supporting weight by one arm.

This position was maintained for thirty-three minutes.

(From "The Grasping Reflex in the New-born Monkey" by C. P Richter, *Arch. Neurol. and Psychiat.*, 1931, 26: 784-790 Courtesy of the publishers.)

He breathes, suckles, sneezes, coughs, and moves his whole body. He starts at a sudden noise, cries if he is hurt, turns his head freely from side to side when lying on his back, and if placed face downward on a bed or table he promptly turns his head so as to free his nose for breathing, or he may even lift his head clear of the table for an instant. If an object is placed in his hand, the fingers close about it, and so strong is this reflex grasp that many new-born infants can support their entire weight by their hands. (See Figure 23.) When at rest, the prenatal posture (Figure 7) is usually maintained by most infants during the first three or four weeks. In premature infants this posture is retained somewhat longer than is the case with children born at full term but not as much longer as might be expected if age alone were to be considered. Not only maturity but opportunity and learning play a part in determining the posture patterns of the young infant.

At Ohio State University * careful studies have been made of the amount and kind of activity shown by the new-born infant. Each baby studied was kept in a glass-enclosed observation room within which the temperature and humidity were always maintained at the same point. His bed was an ingeniously contrived bit of apparatus balanced in such a way that every movement that he made was recorded by a pen writing on a revolving drum. At the same time, the kind of movement—whether of the arms, legs, head, or entire body—was noted by an observer stationed outside the enclosure. The results of these studies have shown that mass activity rather than independent movements of the separate parts of the body greatly predominates during the first ten days of life and that activity occurs even when all external conditions remain the same. The stimulus for these move-

* Orvin C. Irwin, "The Amount and Nature of Activities of New Born Infants under Constant External Stimulating Conditions During the First Ten Days of Life," *Genet. Psychol. Monog.*, 1930, 8, No. 1, Pp. 92.

ments must therefore come from within the child's body, through the organic senses. The predominance of mass activity is in accordance with the behavior already described as characteristic of the fetal period. It shows that the neural mechanism has not yet developed to a point at which local movements have become well separated from movements of the body as a whole.

In a further and more extensive study from the same laboratory, Pratt, Nelson, and Sun * reach the following important conclusion:

> "The infant at birth represents an organism in which differentiation has proceeded to a point at which there are many effectors and many receptors. Its behavior, however, is generalized, that is, stimulation of almost any group of receptors by almost any kind of stimulus will lead to a response in almost any part of the organism.† The reaction tends, however, to manifest itself most strongly in that part of the organism which is stimulated, and from there, spreads out with decreasing frequency and intensity to other segments of the body. This does not mean that the activity within any given segment is well coördinated."

For example, it was found that although the child's reactions to light were most often eye-movements, there were also movements of other parts of the body apparently in

* K. C. Pratt, A. K. Nelson and K. H. Sun, "The Behavior of the New-born Infant," *Ohio State University Studies, Contributions in Psychology*, No. 10, 1930.

† In a third study from the Ohio State laboratory in which the infant's responses to differences in taste and temperature stimuli were studied by means of very carefully adjusted mechanical devices, Jensen suggests that this statement should be modified so as to read, "Stimulation of almost any group of receptors by almost any kind of stimulus will lead to a response in almost any part of the organism that is set to respond." For example, he found that pulling the hair or pinching the toe of a baby that had temporarily stopped nursing because its hunger was nearly satisfied would always cause nursing to be resumed if the nipple was in the mouth at the time. The baby was still "set" to nurse, and any stimulus given, no matter what it was like, would lead to a resumption of nursing as a response. Cf. Kai Jensen, "Differential Reactions to Taste and Temperature Stimuli in New Born Infants," *Genet. Psychol. Monog.*, 1932, 12, Nos. 5-6, pp. 391-479.

response to the light as stimulus. A touch on one part of the body was most likely to cause movement in the part touched, or the movement of that part would be most extensive and prompt, yet the entire body was likely to participate in the reaction to some extent. In the generalized reaction, the response tended to be strongest in the parts stimulated and weakest in the parts most distant from the stimulated area.

Although mass movements predominate, local movements also occur more or less independently of the movements of the remainder of the body. In his early studies of infants Watson gave particular attention to these local or reflex movements. Of particular interest is his study of the so-called defense movements of the infant. If the nose is slightly pinched, the child's hands move upward and strike at the experimenter's fingers within a few seconds. If the inner surface of one knee is pinched, the opposite foot is brought up as if to kick the offender. Both these reactions were frequently observed during the first week of life.* A more recent study by the Shermans † emphasizes the irregularity of these local responses immediately after birth and their rapid improvement thereafter, which is probably due in the main to recovery from the shock of birth. They found no coördination of the arms in defense reactions before the age of twenty-one hours, but it was present in all after the age of 108 hours. At first the pupils do not contract when a bright light is thrown into the eyes, but on the second day the reflex appears in most cases. The Babinski reflex, so-called, which consists in an outward and upward extension of the great toe and a fanning-out of the other toes when the sole of the foot is stroked with a blunt object, was found both by the Shermans and by

* J. B. Watson, *Psychology from the Standpoint of a Behaviorist* (Philadelphia: J. B. Lippincott Company, 1919).

† M. Sherman and I. C. Sherman, "Sensory-motor Responses in Infants," *J. Comp. Psychol.*, 1925, 5: 53-68.

Watson to be very irregular during early infancy. Sometimes it appeared, sometimes there was no response; according to the Shermans, repeated stimulation sometimes brought about a change to the plantar form of the reflex in which the toes, instead of fanning out, curl inward toward the sole of the foot. This last is the normal reflex after early infancy. It has been assumed by physicians that the Babinski form of the reflex is associated with incomplete myelination in certain parts of the brain and that as soon as myelination is complete the plantar reflex will appear in place of the Babinski. For this reason, considerable importance has been attached to the reflex as a sign of neural development, but recent findings make the theory seem rather doubtful.

The Sensory Reactions of the New-born Baby

In the last chapter we emphasized the precocious development of the child's sense-organs. It now remains for us to see how well his sensory equipment is able to function at birth or shortly afterward. The most careful studies on this subject that have appeared to date are those carried out at Ohio State University by Pratt, Nelson, and Sun.* They found that during the first two weeks of life infants would react to a white light of about four and one-half candlepower in about 95 per cent of all stimulations. They also reacted to colored lights, but apparently brightness rather than color was the determining factor; there was no evidence that the babies responded to color as such.† Reactions of the eyes were most numerous, but responses of many other parts of the body also occurred.

Reactions to sound were less frequent. They occurred in slightly less than half of all trials. While the frequency

* *Op. cit.*

† The ability of infants to perceive color will be considered in more detail in a later chapter.

increased only slightly with age, the writers suggest that habituation to sound within the nursery (the children in this group were not kept continuously within the experimental cabinet as were those in the study by Irwin previously mentioned) was in part responsible for the small increase. This is understandable enough. We all know how quickly we become used to sounds that occur often. People who live near an elevated railroad soon cease to be disturbed by the rattle and roar of the trains that pass just outside their windows; the farmer is not bothered by the evening song of the frogs; the office worker pays no attention to the clattering typewriters around her. In my own experiments with young infants I have frequently noticed that a sound of unusual pitch or timbre would elicit responses from the infants when a much louder sound more nearly resembling those to which they were accustomed had no apparent effect. It seems probable that, in part at least, the low percentage of responses to sound shown by young infants may be attributed to the fact that the sound stimuli used have little or no greater stimulating value than other sounds in the neighborhood. Accordingly, although a given sound may be heard by the child, the observer has no way of knowing that it is heard unless some kind of bodily movement is made in response. Since it is not necessary for the child to move his ears in order to hear as he must move or fixate his eyes in order to see, it is unsafe to assume that he does not hear merely because he makes no response that an observer can detect. Some children, to be sure, are known to be totally or partially deaf for a few days after birth as a result of the middle ear becoming filled with the amniotic fluid,* but this usually drains off within a few days. After this the child probably hears many sounds

* Before birth the child is enclosed in a double membrane, in which the space between the two layers is filled with a fluid known as the amniotic fluid. The purpose of the fluid is to equalize support and dissipate the force of shocks or jars.

to which he makes no response that other people can see.

The Ohio babies were tested to see how they would respond to taste stimuli. Weak solutions of sugar, citric acid (sour), quinine (bitter), and salt were used. Plain water was also tried to make sure that their responses were to the tastes, and not simply to the feeling of something wet in the mouth. The babies responded to 85 per cent of all stimulations, usually by sucking, with facial grimaces and movements of head, body, and limbs often accompanying the sucking. Their responses to the plain water were much less pronounced than those to the flavors, showing clearly that taste was functioning, but they did not respond as an adult would have expected. Their reactions to the citric acid were much more pronounced than their reactions to the quinine. Adults who tried the solutions were unanimous in reporting that the quinine had a much stronger and more unpleasant taste than the citric acid. This affords another example of the fact that our sensations depend upon the reactions of our sense-organs, and that if the sense-organs differ the sensations will also differ even though the stimulating object remains the same. It was pointed out in an earlier chapter that the distribution of taste-buds in the infant is not the same as it is in the adult, and this probably accounts for the differences in their reactions to the same taste solutions.

The sense of smell was tested by forcing into the child's nostrils a puff of air that had previously been saturated with an odor of some kind. A non-odorous puff of air was used as a control. Here, as in the case of hearing, we are dealing with a sensation for which the sense-organ lies far back in the head and for which there are no very characteristic reactions. Responses were observed in a little less than half of all trials and were much less frequent when the puff of air was used alone than when an odor was used. As with

the sense of taste, the infants' reactions did not follow exactly the same order as an adult would have expected. The reason for this is difficult to interpret because we do not know very much about the way the sense of smell works. We know that different substances have different odors, but these odors are very hard to classify, and because the receptors for smell cannot be got at and stimulated separately as can the taste-buds in the mouth, we do not know how it is that they give us different sensations. In the case of taste, certain taste-buds respond to sweet, others to sour, and so on. If, as seems probable, the same thing is true for smell, it may be that the receptors for smell, like those for taste, are differently distributed or perhaps occur in different proportions in the infant as compared with the adult.

Temperature senses were tested by Pratt, Nelson, and Sun by dropping water of different temperatures on the tongue. Jensen used a nursing bottle with milk of different temperatures. The babies' responses to changes in temperature were very marked, showing clearly that the temperature senses are well developed at birth.

We must not suppose, however, that just because the child's sense-organs are active from birth they provide him with the same kind of information that we receive from our senses. It is one thing to possess a tool; it is another thing to know how to use it. The new-born child, it is true, sees, hears, smells, tastes, but he does not understand. When we see an object or hear a sound, the simple sense impression is so bound up with the host of memories that have grown up as a result of our past experiences that it becomes almost impossible for us, except by an elaborate system of analysis, to tell what it is that we see or hear and what it is that we only infer.

I see a tree across the street. The trunk, I say, looks rounded, the bark looks rough, certain branches extend

toward me, others away from me, one branch is broken, there is a hole in the trunk about ten feet above the ground.

What does the baby see there? As a matter of fact he may see nothing, for there is a question whether or not the young infant can see objects at a distance. Assuming that the tree comes within his range of vision, he would still see none of these things. Why not? Because none of them are directly given by sight; they are inferred from certain qualities of the visual object that experience has taught us to interpret in certain ways. Strictly speaking, we do not see that the trunk is rounded, i.e., that it has three dimensions. What happens is that our two eyes, being placed at a little distance from each other, give us slightly different views of the tree-trunk. The left eye sees a little further around one side, the right eye around the other side. In looking at distant objects or at near-by flat objects, the image formed by the lens on the sensitive retina at the back of the eye is essentially the same for both eyes; that is, corresponding parts of the two retinas are affected. The action currents coming in to the brain from the two eyes may thus be said to have the same spatial pattern, and when this occurs the object is perceived as one. Now when the two images are only slightly different, as is the case when we look at a near-by solid object, the incoming nerve impulses still give the sensation of a single object, but the sensation is not the same as that produced by nerve impulses from exactly corresponding parts of the two retinas. Very early in life and without being aware that we are doing so we learn to interpret this difference in visual sensation in terms of the tactual and muscular sensations we get from handling objects that give us visual sensations of this kind. When we say that the tree-trunk *looks* rounded we mean only that the visual sensation has the qualities that from infancy on we have learned to associate with objects that *feel* rounded. The infant at first lacks this experience, and so, even

though his visual sensation may be exactly the same as ours, it does not have the same meaning for him that it has for us.

Another interesting point of binocular vision is the matter of *retinal rivalry*, as it is called, which is closely linked up with the matter of *eye dominance*. Retinal rivalry is best studied in adults by means of an instrument called the

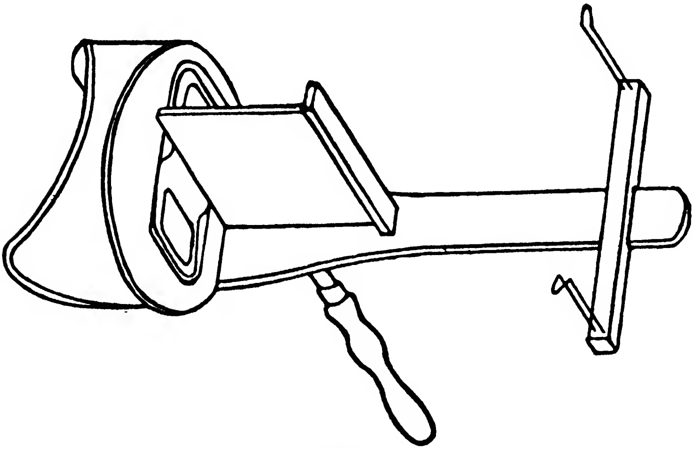


FIGURE 24

THE BREWSTER REFRACTING STEREOSCOPE

(From G. Murphy's *General Psychology*. Courtesy Harper & Brothers, publishers.)

stereoscope, which enables one to present different views to the two eyes simultaneously. A common form of stereoscope is shown in Figure 24. If the two views are exactly alike, the situation is just the same as that which exists in ordinary distant vision or in looking at a flat object with both eyes open. The two views are seen as one. Now if, instead of using exactly similar views, two photographs of the same view taken from slightly different angles are used, we get a sensation of depth, since the situation is like that found

in ordinary examination of near objects with both eyes when the retinal images are not exactly the same. But if the two views are made more and more different, a point is reached at which the brain is no longer able to combine them into a sensible whole and the phenomenon known as retinal rivalry appears. This takes various forms, but the most common one is that in which the two views are seen separately and alternately. In most cases, however, careful timing will show that the alternation is not equally divided. One view will tend to appear for longer periods than the other. One eye thus appears to dominate over the other just as in later life one hand tends to be used in preference to the other. We do not know how either eye or hand dominance is determined, but the matter is one of considerable importance, as we shall see later. Recent experiments have shown that eye dominance is not well established, in most cases, before the age of two or three years.

The perception of distance is another aspect of visual sensation in which binocular vision plays an important part and which the child probably has to learn to interpret by experience. When we look at a near-by object, the two eyes have to converge in order to see it distinctly. The further away the object, the less convergence is necessary. Like the other muscles, the six little muscles that move the eyeball contain receptors (proprioceptors) that are aroused to action when the muscles contract. From the nerve impulses thus transmitted to the brain we get a feeling of eye-movement. This feeling the child learns to translate into terms of distance, just as he learns to translate the sensations arising from retinal images that are slightly different in the two eyes into terms of three-dimensional space. As he grows older, other factors, such as clearness of outline, size of the retinal image (perspective), and the concealment of parts of the background by objects in the foreground also come to serve as cues by which distance is judged. All this

is learned so early in life that we have no recollection of it, but it is very doubtful if the new-born child can interpret his visual sensations in these terms before experience has taught him to do so. Thus the visual sensations of the new-born child must affect him very differently from the way the same sensations affect us, because he has not learned what they mean. He has not learned to interpret one kind of sensation in terms of other experiences, which, after all, is the basic thing in all knowledge.*

Apart from the interpretation that comes from experience, the visual sensations of the new-born child probably differ from ours in at least one more fundamental way. This is in the matter of color-vision. As was pointed out in an earlier chapter, the retina contains two kinds of sensitive cells or receptors, known from their shape as the *rods* and the *cones*. Both the rods and the cones are active in the perception of form, though the cones seem to be more effective. Color is responded to only by the cones.† At birth the cones are not very well developed, and there is accordingly some question whether or not the new-born child can respond to color as

* In fairness it should be stated that not all psychologists agree with the point of view presented here. It is thought by some that the perception of such spatial qualities as distance, form, depth, and so on is a direct product of the visual apparatus and does not have to be learned. The matter is hard to check with certainty because of the fact that visual perception is undoubtedly perfected at so early an age that the major features of any learning that takes place must occur in fairly early infancy. We may ask, however, how it is that if the perception of spatial qualities is independent of the utilization of such secondary cues as convergence, similarity or dissimilarity of the retinal images, perspective and the like, alteration of these cues results in such striking illusions of perception. Certain medieval painters were adepts at producing these illusions. By means of clever tricks of foreshortening and shading, mural paintings are made to appear like solid objects; figures of men and animals apparently reverse their positions as you change yours; and the apparent length of a room is increased many-fold by appropriate arrangement of the mural decorations.

† Just what the physiological mechanism is by which the cones respond to light has been a matter of psychological controversy for more than half a century. We shall consider the various theories of color-vision in Chapter XI in connection with the experiments on the beginning of color perception in infancy.

such. Recent experiments such as those carried out at Ohio State University make it seem very doubtful that he does so. Although he responds to both white and colored lights, he does not apparently respond more strongly to one color than to another. The intensity of the response seems to vary according to the brightness of the light, not according to its color.

Much the same situation exists with regard to the child's other sensations as we have seen to be the case in his responses to light and form. Consider the matter of hearing. Leaving out of account the question of acuity of hearing, it is certainly true that sounds can at first have no particular meaning for him, and there is no evidence of any innate tendency to respond selectively to certain sounds rather than to others. The young wood-grouse, within a few hours after hatching, will run to cover at the sound of a warning note from its mother, but if babies have any such inborn responses to particular sounds no one has discovered them. Tastes and odors have none of the complicated associations that they have taken on for us. All this has to be learned, and the process of learning begins almost as soon as the child is born; it is possible that some learning of a primitive and simple kind may take place before birth. But learning, let it be understood from the start, is not the coldly abstract, intellectualized kind of performance that many people think it to be. Nothing in life is more closely bound up with the affective side of our natures, with our feelings and emotions, our likes and dislikes, our pleasures and displeasures. We strive to repeat those acts that satisfy us or give us pleasure and to avoid those that in the past have resulted in discomfort, pain, or dissatisfaction. So from birth onward the feelings and emotions that go along with our every act are the real factors that shape our lives. It is they that give color and meaning to experience, that turn us toward this activity or away from that, that guide us alike

in the choice of our toys, our neckties, our occupations, and our wives. How do these powerful forces act?

The Feelings and Emotions of the New-born and Their Relation to Learning

That the new-born baby has dislikes and displeasures, that he experiences pain and discomfort, he soon gives us reason to know. Indeed to many persons the word *crying* attaches itself to the word *baby* almost as naturally and inevitably as the night follows the day. Less conspicuous but almost equally definite are the child's manifestations of an organic state that we may best describe as contentment and relaxation. Moreover, from the very beginning we can see in his behavior an important general trend: a tendency to remain comparatively quiet and relaxed under conditions that we regard as pleasant, a tendency to become tense and to struggle under unpleasant conditions. We cannot suppose that the baby analyzes or understands the conditions to which he reacts any more than he understands the sensations of light and sound that come to him through his eyes and ears and to which he responds by movements that also show some degree of adaptation to the kind of stimulus, since they tend to be greatest near the stimulated areas. In both cases there is first a stimulation of the sense-organs—perhaps of the eyes and ears, perhaps of the pain receptors in the skin (it may be that a pin is pricking him), or perhaps of the interoceptors for stomach-ache or fatigue. At all events, an organic state is aroused that makes for further activity.

But matters do not stop there. The activity thus aroused extends into the muscles and glands, and the baby does things that change his relationship to his environment. He kicks, thrashes around, cries, and screams until finally something happens. If this "something" proves to be satisfying, the activity comes to an end. If it is not, if the sense-

organs continue to be stimulated, if the pin keeps on pricking or the stomach keeps on aching, the activity will continue until a satisfactory state of affairs has been reached. And this final attainment of satisfaction appears to have some kind of lasting effect upon the organism, so that on other occasions when the same kind of organic state is aroused there is a tendency for the baby to repeat the actions that brought satisfaction and to omit those that did not work. Not only that, but the objects and events that were associated with the experience have taken on meaning for him. They have become things to be avoided or signs that satisfaction is on the way. We can make this more clear by an example.

A baby is alone in his crib. Gas has accumulated in his stomach and intestines, causing him to feel pain. He cries, kicks, and slashes his arms up and down. This behavior, we say, is native and unlearned, it is due to neurological connections established before birth. Now his mother or nurse comes and lifts him, at the same time speaking to him gently. The change of position forces the gas upward, he belches and is relieved. Likewise the change of position is a relief to tired muscles, the contact with another's warm body is pleasant, and if, as often happens, his skin is stroked and patted, there is pleasant stimulation of the tactile receptors. Thus we have stimulation of the receptors for vision (sight of the mother or nurse), hearing (sound of her voice and step), touch, and posture sense, all occurring simultaneously with relief from pain and pleasant stimulation of the receptors for warmth and touch. As a result, when some part of this experience is repeated on another occasion, the reactions appropriate to the total original situation tend to be aroused. The child sees his mother or hears her voice and becomes quiet and relaxed for a moment. The mother exclaims, "See, he knows me," and in a way she is right, for in this linking together of

situation and response in new combinations lies the beginning of knowledge, the first step in the modification of behavior through experience.

That the neural mechanism is modified and the relationship of the neurons to each other is changed by experiences such as these seems certain, but we do not know in what the change consists. We do know that the neurons are separate units that never fuse with each other, the nerve impulses passing from one neuron to another through contact at the synapses between the axons of one neuron and the dendrites of another. It has been suggested that when nerve impulses once pass over a synapse, the resistance at this point is lowered, so that later disturbances of the same kind will tend to follow the same path instead of being shunted off to another connection. Another possibility that has been particularly stressed by some of the more recent investigators is the theory that through exercise the nerve-fibers, particularly the dendrites, become slightly lengthened, just as a muscle enlarges through exercise. The amount of extension necessary to reinforce or strengthen a connection would be almost infinitesimal, since the original passage of the impulse shows that some sort of a connection, though perhaps a poor one, already existed. According to this theory, learning has much the same neurological basis as growth and maturation.

A point that is not adequately explained by either theory is the relationship of learning to the subject's organic state at the time and to the feelings and emotions aroused in connection with the situation. Yet these are of great, perhaps of chief, importance. It has long been recognized that the effect attached to an act has an important bearing upon the likelihood of its repetition. Thorndike calls this the Law of Effect, and in 1911 he formulated its operation as follows*:

* E. L. Thorndike, *Animal Intelligence* (New York: The Macmillan Company, 1911).

"Of several responses made to the same situation, those which are accompanied or closely followed by satisfaction to the animal will, other things being equal, be more firmly connected with the situation, so that, when it recurs, they will be more likely to recur; those which are accompanied or closely followed by discomfort to the animal will, other things being equal, have their connections with that situation weakened, so that, when it recurs, they will be less likely to occur. The greater the satisfaction or discomfort, the greater the strengthening or weakening of the bond."

More recent experiments have led Thorndike to place even greater stress upon the importance of this law than he did in 1911.*

The above statement describes what happens but does not tell how or why it happens, and no explanation has yet been offered that has met with general acceptance. A theory that has attracted much attention in recent years is the "closure" theory promulgated by psychologists of the *Gestalt* school and most clearly elaborated by Koffka.† According to this point of view, for the organism as a whole and particularly for the nervous system there is a certain fixed state or condition that is normal for the organism, and to this state it always tends—we may say "strives"—to return whenever this condition is disturbed. Any stimulation of the receptors, whether of the interoceptors, the proprioceptors, or the exteroceptors, upsets the equilibrium and puts the organism into a state of restless activity, of striving toward a goal. It is not necessary that the goal be foreseen in advance or that the individual himself be aware of his condition or of the object he is trying to attain. The new-born baby could not know these things. Nevertheless, it is entirely possible for him to be in such a state of unrest as is described, a condi-

* E. L. Thorndike, *Human Learning* (New York: The Century Company, 1931); *The Fundamentals of Learning* (New York: Bureau of Publications, Teachers College, Columbia University, 1932).

† Kurt Koffka, *The Growth of the Mind; an Introduction to Child Psychology* (New York: Harcourt, Brace and Company, Inc., 1927).

tion in which activity persists until some kind of solution or goal is attained. With the attainment of the goal, the series of activities is completed or "closed." Now on later occasions, not only the goal but the various transitional states or acts by means of which the goal was reached take on a special quality of meaning. To use a rather striking expression frequently employed by the psychologists of this group, they have come to stand out like a pattern against an undifferentiated background. Such a pattern is called a "configuration," and it is postulated that when on subsequent occasions the first part of the pattern occurs, i.e., when the subject is faced with the same external conditions as before, there will be a tendency for the whole pattern to run off in much the same form, like the completing of a musical phrase after the first few notes have been sounded. Although this theory does not offer any kind of neurological explanation of learning but merely postulates a condition analogous to a physical system of equilibrium, nevertheless the general idea is valuable because of its emphasis upon two points that are often insufficiently stressed: (1) the fact that learning is not simply a linking of new pathways in certain parts of the nervous system but is an activity that involves the entire organism and (2) the fact that the affective state of the individual, his feelings and emotions, his organic drives, and his strivings toward a goal the nature of which he may or may not foresee in advance are matters of primary importance in determining the direction and character of his learning and his retentiveness for things learned.

Are there any other known factors that might help to explain the relationship between the satisfaction or dissatisfaction that results from an act and the likelihood that it will be repeated? Two possibilities may be mentioned. Although we speak of the nervous system as the chief integrating mechanism of the body, there are other bodily systems that

have an integrating function. Perhaps the most important of these is the blood, which goes to all parts of the body carrying food and oxygen to all the tissues including the nerve-cells themselves. Now there are within the body a number of glands, called the *endocrine* or *ductless glands* because they discharge their products directly into the blood stream. These products, or *hormones* as they are called, are carried by the blood to all parts of the body, and they exert very marked effects upon bodily activity and behavior and upon mental and physical growth. We shall have more to say about these glands later on, but for the present we may note that under the stress of strong emotion and to a lesser extent in milder stirred-up states of the organism some of these glands are stimulated to greater activity and pour out larger quantities of their hormones into the blood stream, while the action of others is inhibited. Of particular importance in this connection are the adrenal glands, small bodies that lie just in front of each kidney. The inner parts of these glands secrete in very minute quantities a hormone called *adrenin* (or *adrenalin*). One of the chief functions of adrenin is that of helping to maintain a normal state of muscular tonus. It effects this by its control over the amount of blood-sugar that is released from the liver. Blood-sugar is the chief source of muscular energy; it is stored in the liver and muscles and delivered to the muscles through the blood stream as it is needed. Now under the influence of strong emotions, particularly fear or rage, the adrenal glands are stimulated to increased activity, more adrenin is poured into the blood, and the effect of this increased supply upon the body is marked and widespread.* The pupils of the eyes dilate, the fine hairs on the surface of the body stand erect, digestion stops, and sugar is released from

* The effect of adrenin in the blood is identical with that of the sympathetic division of the autonomic nervous system described on pages 150-153.

the liver in excess quantities as if in preparation for a sudden emergency. So, whenever the emotional state of the individual is changed, whenever he is distressed, frightened, hurt, or excited, the hormone content of the blood becomes changed, and, since these glands discharge directly into the blood, the change takes place very quickly. It is a far cry from showing that two things occur together to proving that they have any relationship to each other, and we do not know that the hormones in the blood have anything whatever to do with the neurological changes that take place in learning. Nevertheless, whether these changes involve a modification of resistance at the synapse to the passage of action currents in the nerve or the growth of the physical connections at the point of synapse, it seems probable that some kind of biochemical process is involved, and if this is so it may be found that hormone action plays an important part in learning.

Another possibility has to do with the part of the nervous system that is most intimately concerned with the arousal of emotional states. These are the *autonomic nerves,* a series of nerve fibers that have their origin in cell bodies lying for the most part within a series of ganglia that run alongside the spinal column. In some cases the cell bodies are found within the organ that they innervate; this is the case in the heart and in the stomach. In the head and in the lower pelvic region, the ganglia are placed near the organs which the nerves supply.

The autonomic* nervous system is so called because it controls the actions of the smooth muscle fibers of the internal organs over which we have but little voluntary control. Its nerves run to the stomach, the intestines, the heart, the lungs, the walls of the blood-vessels, the ciliary muscles

* *Autonomic* means "self-governing" or "(relatively) independent," but as will be seen the term is only partially appropriate; for, although the autonomic nervous system sometimes works independently of the central nervous system, it does not always do so.

that dilate or contract the pupils of the eyes, the sweat-glands, the liver and other viscera, and the ductless glands themselves. It maintains its connection with the central nervous system by means of a series of neurons with cell bodies in the cord and in the brain stem that send their axons out to the autonomic ganglia and make synaptic connection with them. Thus, although it is able to carry on its everyday functions of regulating the vital processes of the body without the direction of the brain, the autonomic system is nevertheless capable of being influenced by brain action, by thoughts, ideas, associations. The student at the start of an important examination may turn pale and perspire; his breath may come quickly and his heart beat faster. All these physical symptoms are the direct result of the action of the autonomic nervous system, but their starting point is in the brain. So the autonomic nervous system is connected at all points with the central nervous system and works along with it. It should not be thought of as an independent organization of neurons, but as a part of the general nervous system that has taken on certain specialized functions.

The fibers that connect the autonomic ganglia with the central nervous system do not leave the cord in a regular unbroken series but are divided into three distinct groups: (1) an upper group that has its origin in the brain stem and is known as the *cranial division,* (2) a middle group that runs out from the thoracic and the upper lumbar regions of the cord and is known as the *sympathetic division,* and (3) a lower group that emerges from the sacral part of the cord and is called the *sacral division.*

The cranial division of the autonomic system is particularly concerned with the process of digestion, the movements of the stomach, the secretion of saliva and of gastric juice. By its action, too, the pupil of the eye contracts and the heart rate is slowed. All this goes along with a caim, relaxed,

organic state. The baby who has just been fed drops peacefully off to sleep. When the child who is "hungry and cross" is given food, the crossness usually disappears along with the hunger. It is a stupid wife who has not learned to take advantage of her husband's after-dinner mood.

The fibers of the sacral division run out to the organs that have to do with the removal of waste material from the body. Like the cranial division, they are concerned with processes that make for greater comfort. They also innervate the contractile tissues of the external genitals and thus are actively concerned in sex emotion.

Unlike the fibers of the two foregoing divisions, which run to only a small group of specific organs and in general make for organic states of calmness, peace, relaxation, and pleasure, the nerves from the sympathetic division are widely distributed over the entire body. Wherever they are found, their relationship to the action of the cranial and sacral divisions is antagonistic. The cranial supply to the eye contracts the pupil, the sympathetic dilates it; the cranial slows the heart, the sympathetic accelerates it; the sacral contracts the large intestine and relaxes the exit from the bladder, the sympathetic relaxes the intestine and contracts the exit from the bladder.* And the organic states that accompany the action of the sympathetic division are, as might be expected, the opposite of those that go with the activities of the cranial and sacral divisions. Instead of peacefulness, calm, contentment, relaxation, we have excitement, anxiety, restlessness. Moreover the entire sympathetic system is connected up by fibers that run from one ganglion to another (see Figure 25) in such a way that when the system goes into action not one but all the organs which it innervates are affected. Under strong emotion this is very apparent to every one. In extreme excitement the pupils of

* In coöperation with the action of the central nervous system. Elimination is partially automatic, partially voluntary.

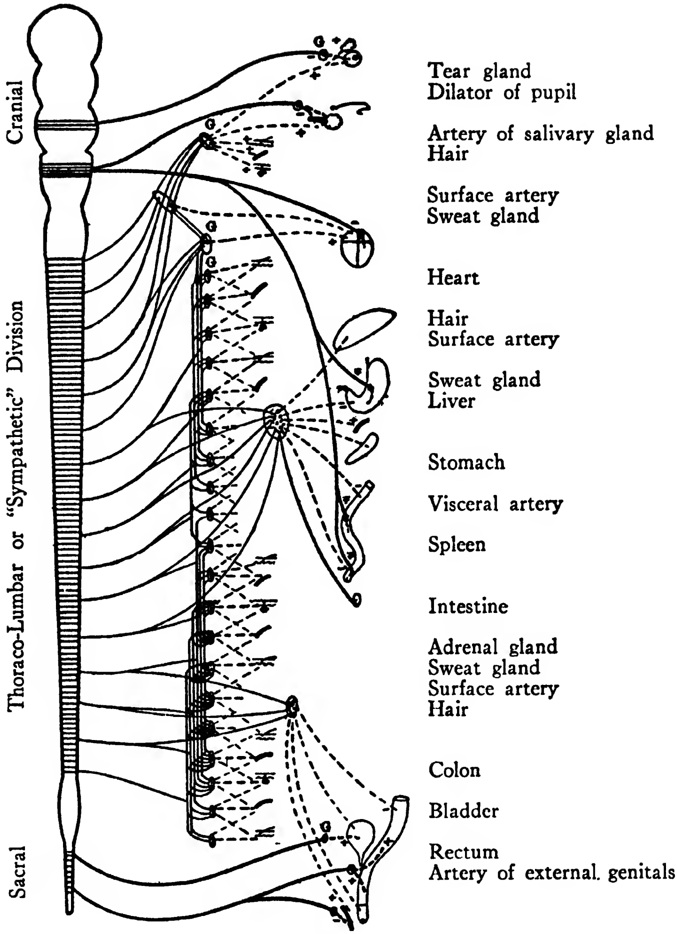


FIGURE 25

DIAGRAM OF THE MORE IMPORTANT DISTRIBUTIONS OF THE AUTONOMIC NERVOUS SYSTEM

The brain and spinal cord are represented at the left. The nerves to skeletal muscles are not represented. The preganglionic fibers of the autonomic system are in solid lines, the postganglionic in dash-lines. The nerves of the cranial and sacral divisions are distinguished from those of the thoraco-lumbar or "sympathetic" division by broader lines. A + mark indicates an augmenting effect on the activity of the organ; a — mark, a depressive or inhibitory effect.
(From *Bodily Changes in Pain, Hunger, Fear, and Rage* by W. B. Cannon. Courtesy D. Appleton and Co.)

the eyes dilate, the heart beats fast, the breath comes quickly, the muscles at the base of the fine hairs on the skin contract and the hairs stand erect (this is more easily seen in animals than in human beings), the mouth becomes dry, and perspiration pours out on the skin. The sympathetic discharge is thus seen to be diffuse rather than specific, while the sacral and cranial discharges may affect single organs without inducing any change in others. The process of digestion does not necessarily affect the flow of saliva once the food has been swallowed; the bladder may be emptied without intestinal action. In this connection, Cannon * aptly compares the sympathetic system to the loud and soft pedals of a piano which modulate all the notes together, while the sacral and cranial divisions are like the keys, acting either separately or in combination.

In the action of the autonomic nervous system, then, we have another mechanism † that may have a bearing upon the relationship between organic states and learning. There can be no doubt that the action of these nerves is associated with general organic states. We know also that the parts of the autonomic nervous system associated with the pleasant, satisfying states that make for positive learning (repetition of the same acts under similar conditions),—namely, the cranial and sacral divisions—are quite distinct from the sympathetic division, the part that is associated with pain-

* W. B. Cannon, *Bodily Changes in Pain, Hunger, Fear and Rage,* second edition revised (New York: D. Appleton and Company, 1929).

† Strictly speaking, the action of the autonomic system is not independent of hormone action, for the autonomic nerves control the working of the endocrine glands and it is through their action that the amount of the various hormones supplied to the blood is varied. However, it is possible that a direct relationship of some unknown character may exist between the part of the autonomic system that is stimulated to increased action and the changes in synaptic resistance within the central nervous system that are now thought to be at the basis of learning. In this case the hormones would have nothing to do with it. If, on the other hand, the hormones were the direct agents bringing about the change, the autonomic nervous system would still be involved, but as an indirect rather than a direct factor.

ful, anxious, angry, or fearful states that make for avoidance of the acts by which these unpleasant results were brought about. Perhaps we should not be far wrong if we were to paraphrase Thorndike's reading of the Law of Effect as follows:

Of several responses made to the same situation, those which are accompanied or closely followed by increased action of the cranial or the sacral divisions of the autonomic nervous system will, other things being equal, be more firmly connected with the situation, so that, when it recurs, they will be more likely to recur; those which are accompanied or closely followed by increased action of the sympathetic division, will, other things being equal, have their connections with that situation weakened, so that, when it recurs, they will be less likely to occur. The more intense the action of the autonomic nervous system, the greater will be the strengthening or weakening of the bond.

All this is hypothetical. We do not know the true nature of the relationship that unquestionably exists between the affective states of a child or an adult and the manner in which his behavior patterns are modified. Yet, as we have seen, there are in the body a number of mechanisms that might account for it, and we do not need to invoke any vitalistic explanation in terms of a disembodied "mind" to account for what takes place. When all is known, we shall probably find that learning is quite as mechanical an act as digesting, the chief difference being that it is an act in which the entire organism participates and not simply a limited part of the organism.

Before leaving the question of organic states it is worth while to ask whether the new-born baby experiences such relatively distinct emotions as fear, anger, and jealousy. At birth and for some time thereafter he probably does not. It is true that Watson, as a result of his pioneer investigations with infants in the Johns Hopkins laboratory came to the conclusion that there are three "primary" emotions,

present at birth and easily recognizable from the child's behavior, viz., fear, rage, and love. Fear is supposed to be aroused by loud sounds or the removal of bodily support, and to be characterized by a sudden catching of the breath, random clutching with the hands, sudden closing of the eyelids, and puckering of the lips followed by crying. Rage is said to be aroused by hampering of the child's bodily movements. The behavior characteristic of rage is described as crying, quickly followed by screaming, stiffening of the body with fairly well coördinated slashing or striking movements of the hands and arms, kicking, and holding the breath. The situation supposed to induce the love response is stimulation of the erogenous zones by stroking or patting, gentle rocking, and cuddling. The response is cessation of crying, smiling, cooing, and gurgling. According to Watson, these are the only native or unlearned emotions, and in the beginning they can be aroused only by the situations described. Later, as a result of experience and particularly as the result of a special kind of emotional experience known as "conditioning" that will be described in a later chapter, other situations become effective in arousing emotion, but these are learned reactions and not a part of the child's original equipment.

Because of the simplicity of this theory, which puts emotional behavior in much the same class as the knee-jerk that can be aroused only by a tap on the patellar tendon and when aroused always takes the form of a sudden forward jerk of the foot, Watson's account of the genesis of emotional behavior in the infant has been quoted in almost every textbook of elementary psychology that has appeared since that time. Recent experiments, however, have failed to confirm his observations. Sherman,* for example, found

* M. Sherman, "The Differentiation of Emotional Responses in Infants. I. Judgments of Emotional Responses from Motion Picture Views and from Actual Observation," *J. Comp. Psychol.*, 1927, 7: 265-284.

that neither trained nor untrained observers could distinguish between the behavior of an infant a few hours old who had just been pricked with a needle, one who had been dropped a few inches on to a pillow, one whose feeding had been delayed, and one whose bodily movements had been restrained by holding the arms at the sides. The babies were clearly disturbed and displeased, as was shown by their crying and struggling, but the distinct and characteristic behavior patterns described by Watson were missing. If different emotions were evoked by the different situations, there was nothing in the babies' behavior to show it. The Ohio babies previously mentioned were tested with only one of these situations—that of restricting the bodily movements—but here again there was nothing distinctive about their behavior. When the nose was held there was some kind of response in 96 per cent of the cases, but the response was generalized and not specific. The babies struggled and perhaps cried, but that was all. When the arms were held, contrary to Watson's assertions, most of the babies responded very little or not at all; the stimulus was ineffective. Other investigators who have tried out the Watson situations with young infants have met with similar results. Attractive as Watson's formula is, with its neat arrangement of a particular stimulus leading to a definitely patterned response, we shall probably have to discard it. The newborn baby cannot tell us how he feels, and all that we can be sure of from his behavior is that under certain circumstances he shows generalized reactions suggesting pain, discomfort, or displeasure on the one hand and content, relaxation, and perhaps a kind of mild pleasure on the other. His emotional reactions, like his other forms of behavior, are at first general rather than specific. As age advances and experience increases, they take on more distinct patterns and become more clearly adapted to the conditions under which they occur. Until this differentiation has reached

a point at which separate emotional patterns can be distinguished, we are hardly warranted in ascribing to the young infant the relatively clear-cut emotional reactions and attitudes that we, as adults, experience.

Chapter VIII

THE PERIOD BEFORE SPEECH: PHYSICAL GROWTH AND MOTOR DEVELOPMENT

Why do we study the course of human development in sections rather than as a whole? Is there any single basis upon which the division into periods should always be made?

What part of the brain grows most rapidly during the first year and why is this significant?

In what fundamental way does the pattern of physical growth after birth differ from that which takes place before birth?

At what age does hand preference develop? What factors presumably account for the fact that most people use the right hand more than the left?

Do children have to be taught to walk?

What is the effect of practice upon such basic motor skills as eating, handling objects, and climbing steps?

At about what age do most children begin to talk? Does talking or walking usually appear first?

Phases of Human Development

Within two or three days after birth the grosser effects of birth trauma have usually disappeared, and by the end of ten days or two weeks physiological adjustment to the new life has been pretty well accomplished. In most cases the birth weight has been regained by this time, the processes of digestion and assimilation of food are fairly well established, and if the child has been well managed the begin-

ning of adjustment to the daily routines of life can already be seen. He sleeps for longer periods during the night and stays awake for longer periods during the day. He is more likely to awaken when it is nearly time for him to be fed. So early in life does habit begin to operate!

Under normal conditions, therefore, we may safely look upon the first two weeks as marking the end of the neonatal period of recovery from birth injury and of physical adjustment to the new conditions of life. From this time on the child's mental and physical growth will proceed along lines that in many respects are continuations of the course laid down before birth, but that also reflect the new conditions under which he is now living. Although this growth is steady and continuous, without marked changes or sudden advances from one well-defined stage to another, there are nevertheless a few landmarks along its course that we may use as convenient reference points for dividing our account of human development into periods that make it easier to study. The division used here is arbitrary. No attempt has been made to keep the periods of equal length or to adhere to any one principle in deciding when a division should be made. In some cases a physical or physiological factor serves as the dividing line, in others a mental or intellectual factor; in still others common educational practice or social custom has determined the division. Practical justification for this seemingly haphazard system of classification is found in the fact that the individual functions as a whole and that a change in any factor which affects his growth and behavior along one line will also affect him along many other lines. Children do not grow physically one day and mentally the next, while the third day is reserved for education and social contacts. Growth of all kinds takes place simultaneously. Behavior is determined by the interaction of the basic laws of growth with the particular combination of circumstances under which growth takes place. So, whether we

divide the life of an individual on the basis of such internal factors as physical growth, mental development, and social traits or upon external factors such as education or social experience makes less difference than might at first be expected, for all these processes are going on together and each affects all the rest.

However, if one is studying a particular aspect of development, its salient points can be brought out most clearly if the division into stages is based upon events that are particularly conspicuous or important for the field studied. For this reason the anatomist is likely to divide life into periods of slow or rapid physical growth, while the educator finds it more useful to employ school grades. The psychologist who is interested in total behavior finds that major changes are sometimes introduced by things that are *done to* the child, such as sending him to school for the first time; sometimes by growth changes that *occur in* the child, such as the acquisition of walking or speech, or the onset of puberty. There is no real inconsistency, therefore, in using such apparently diverse facts as these for marking off the course of development into stages that have certain aspects more or less peculiar to themselves, for both internal and external events have psychological importance for the behavior of the individual. We may note, however, that the internal changes which come with growth and development are most conspicuous during childhood and youth, while phases of adult life are most readily set off by such events as the completion of college, choosing a career, marriage, and parenthood.

The First Phase: the Period before Speech

Development during infancy proceeds at so rapid a rate and involves so many fundamental changes in abilities and behavior that any one of a number of conspicuous events might be chosen as a dividing point. Of these, the acquisition

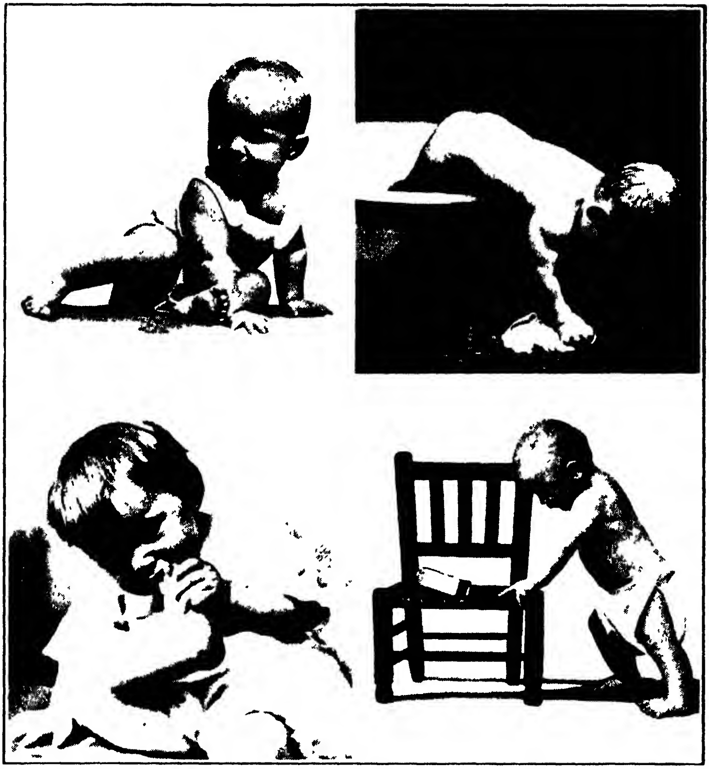


FIGURE 26

SOME EARLY MOTOR SKILLS

(Courtesy *The Parents' Magazine*, G. J. Hecht, publisher. Photographs by Lena Towsley.)

(Compare Figures 56 and 72.)

of spoken language is particularly important, since it brings the child into a kind of social relationship with his fellows that is impossible without the use of language and is accordingly unknown in animals below the level of man. In this chapter, then, we shall try to trace the course of human development during the period before speech has developed to the point of becoming a useful medium of social intercourse. This period, roughly speaking, is from the end of the neonatal period to about the age of eighteen months. The exact age will vary from child to child. Occasionally children as young as thirteen or fourteen months begin to use language as a tool; others do not really commence to talk effectively until after the age of two. In children who are mentally backward, speech may be delayed much longer. Most children begin to develop what might be called a "trick vocabulary" by the time of the first birthday or shortly afterward; that is, they learn to say a few words on demand; but as a rule several months must elapse between the beginning of the "word-saying" period and the time when "word-using" is really established as a spontaneous mode of self-expression. There are no sharp boundaries between the two, since word-saying passes over into word-using by a gradual process of development. Nevertheless, studies of the growth of vocabulary in individual children usually are marked by an initial period of slow growth when language to the child is an accomplishment to be shown off rather than a tool to be used. This period may last for several months. It is followed by a rather sudden upturn in the curve of vocabulary development which marks the time when the child begins to realize, however faintly and indefinitely, that language has possibilities far beyond the mere winning of applause from his elders or even the highly specialized function that he may have come to associate with the utterance of such single words as "dinner," "water," or "bye-bye." From this point on his vocabulary grows

apace and his behavior takes on a number of new aspects that more clearly foreshadow what he will become later on. The baby goes, and the little girl or boy takes its place.

Characteristic Features of Growth During the Prelinguistic Period

Like the prenatal period which preceded it, the period of infancy is characterized by extraordinarily rapid growth in body and mind. During the first five months the birth weight is doubled; it is trebled by the end of the first year. The brain as a whole more than doubles its size. The gain in the first year is about 130 per cent, as compared with a gain of 25 per cent the second year and about 10 per cent the third year. Growth, however, is not equally divided among the parts of the brain. The cerebrum, which was so precocious in growth during the prenatal period, is already beginning to slow down. Its gain in the first year is only about 115 per cent, while the cerebellum shows the enormous increase of 300 per cent. Since, as was pointed out before, the cerebellum is particularly concerned with the control of posture, its rapid growth at the time when the child is first gaining the ability to sit and stand is significant.

Scammon * has shown that at about the time of normal birth a marked change in the growth patterns of the different bodily tissues can be noted. If their prenatal growth is measured in terms of the percentage of their birth weight that has been attained at each prenatal age and the results are plotted to form a growth curve, it is found that each of the different bodily tissues grows at a uniform rate throughout the prenatal period. But if a similar procedure is followed for postnatal growth and the results are expressed in terms of the percentage of the total amount

* R. E. Scammon, "The Measurement of the Body in Childhood," in *The Measurement of Man* (Minneapolis: University of Minnesota Press, 1930).

gained between birth and maturity that has been attained at each succeeding year of postnatal age, it is found that the rate of growth is no longer uniform and that the forms of the growth curves for the different bodily tissues after birth differ greatly from each other. (See Figure 27.) The nervous system grows very rapidly at first and more slowly

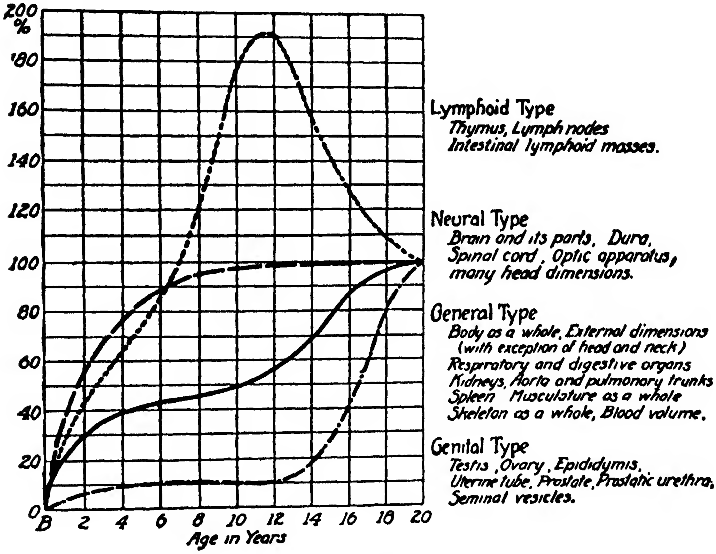


FIGURE 27

FOUR MAIN TYPES OF POSTNATAL GROWTH

(From "The Growth of the Body in Childhood," by R. E. Scammon in *The Measurement of Man.* Courtesy University of Minnesota Press.)

thereafter; it has attained 90 per cent of its adult size by the age of six years. The lymphoid tissues (tonsils, lymph glands, etc.) increase in size up to about the time of puberty and decrease thereafter. The genitals grow very slowly until shortly before the time of puberty and then with extreme rapidity. The postnatal growth curve of the general body tissues, including bones and muscles, blood,

and most of the internal organs, shows a double flexure, with rapid growth at first, then a period of slow growth that lasts until about two years before the onset of puberty, when a second period of rapid growth known as the "pre-adolescent spurt" takes place, after which the growth rate again becomes slower and continues to slow down until adult size has been attained.

Physical growth during the period of infancy is, then, characterized by a very sudden change in the type of growth that is shown by the different bodily tissues. Before birth each tissue grows at a uniform rate; its curve of growth can be represented by a straight line. Shortly after birth these curves change their direction and become curvilinear. Some tend to grow rapidly at first and slowly thereafter; others slowly at first and rapidly thereafter. During infancy the brain and nervous system continue to grow more rapidly than any other part of the body, but the growth of the body as a whole is also more rapid than at any other time after birth.

Changes in behavior proceed at a spectacular rate. Not only is there rapid improvement in functions that are present at birth, but, as a result of simultaneous development along many lines, the total behavior is continually being reorganized into new patterns. The mother says of her baby, "He seems to do something new every day." This is not simply maternal pride. The baby is continually doing new things. Some of these new forms of behavior develop gradually, as a result of the progressive differentiation of the movements of local parts from the mass movements of the young infant. Sometimes they seem to appear suddenly when a number of different local movements become differentiated at about the same time and are rapidly organized into a new total pattern that seems quite different from the parts of which it is composed. We shall find examples of both kinds of developmental change in the sections which follow.

A third characteristic of infantile growth is its orderliness. Orderly growth, to be sure, is not peculiar to infancy. From the beginning of development in the ovum to the time of death, the course of growth is marked by the progressive appearance of a series of mental and physical traits, each in its appointed time and manner. Nevertheless, the fact that this orderliness and regularity of development is not disturbed by the tremendous changes that are imposed upon the child at the time of birth must be regarded as a fact of the greatest importance. One after another, new forms of behavior appear. To-day the child can lift his head and chest clear of the table; to-morrow he reaches for a rattle. Now he can grasp and secure a one-inch cube; a little later he can pick up a tiny button or a thread between his thumb and finger. First he learns to crawl upstairs on his hands and knees; later he becomes able to reverse the performance and come down again. (See Figure 28.) So firmly is this order established by the laws of growth that it is doubtful whether any kind of training known at present is powerful enough to upset it, at least in its major outlines. Some children, it is true, develop more rapidly than others and continue their development for longer periods. These are the children who, we say, are exceptionally "bright." Others, who grow more slowly than the average, we regard as "backward" or "retarded." But no matter what the rate of development may be, no matter whether the child be bright or stupid, quick or slow, the unfolding of his abilities takes place according to a serial order of development that varies but slightly from one child to another. Every child has his own individual *rate* of growth, but though its details may differ, the main *pattern* of growth is much the same for all.

The Development of Motor Coördination in Infancy

At birth, as we have seen, the child's activity consists chiefly of mass movements, with a few specialized responses

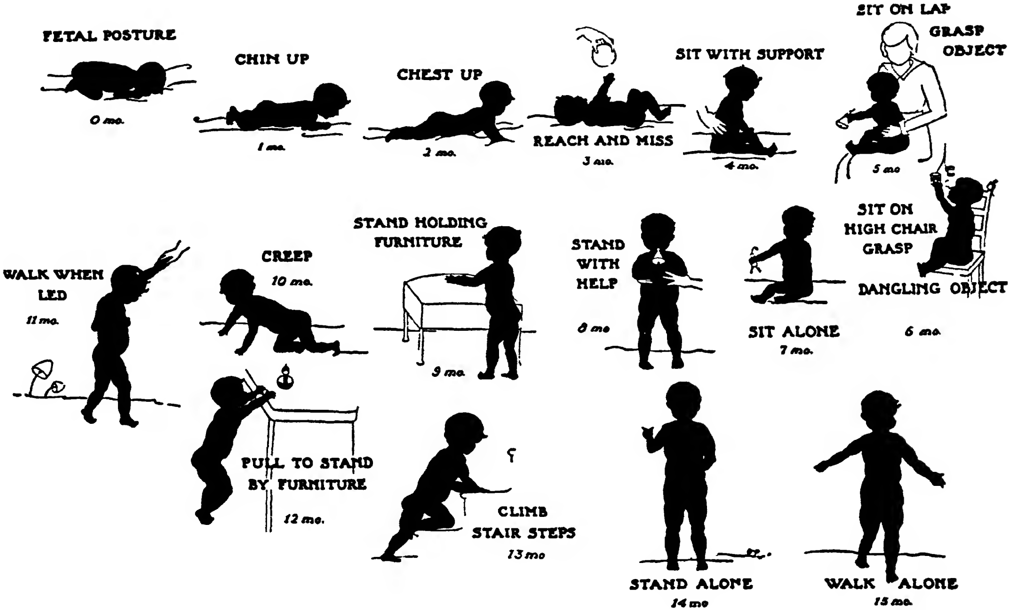


FIGURE 28

THE MOTOR SEQUENCE

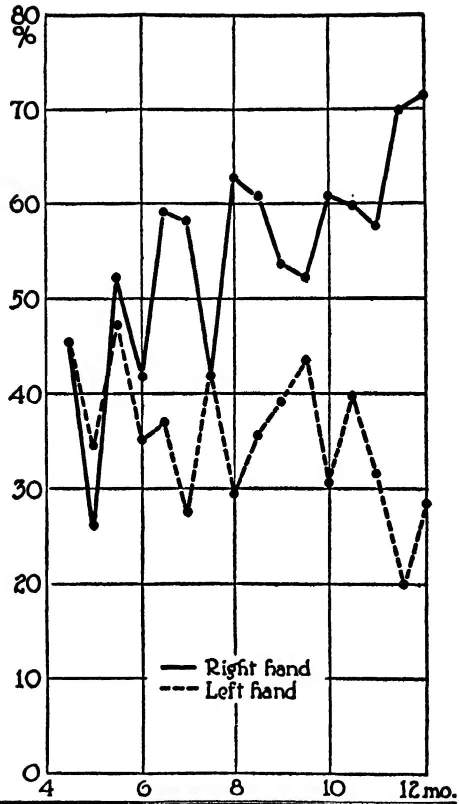
(From *The First Two Years; a Study of Twenty-Five Babies*, by Mary Shirley. Courtesy University of Minnesota Press.)

that are fairly well coördinated. Show the month-old baby a toy, say a rattle, shake it about, and what are the results? He may not respond at all; if he does, the most we can expect is some increase in general activity, perhaps momentary fixation of the eyes on the object, a little harder kicking, a few extra waves of the arms, or mouth movements as in suckling.

Return six months later. The baby who formerly lay helpless on his back is now sitting in his high-chair with only such support as it affords; perhaps he may even be able to sit alone on the floor for a minute or two without toppling over. Show him the rattle. The baby watches with interest as you take it from your bag; his gaze, formerly so uncertain and wavering, now follows your every movement. As you extend the toy toward him he reaches for it without hesitation. The forward thrust of the hand may not be perfectly aimed, but any error in direction is promptly corrected and the extended fingers close about the toy as soon as it is touched. Once in his hand the rattle is manipulated in a dozen different ways. It is waved about, hammered, chewed, sucked, rubbed against his face, passed from one hand to the other, laid down and picked up again, scratched and patted, all with an intentness of expression which rivals that of the scientist engaged in investigating the possibilities of a new laboratory instrument. The remarkable advance in motor abilities that has taken place in the short space of six months is seen in every movement; in his posture with erect neck and shoulders and well-coördinated head movements, in the dexterity of his hand movements and his ability to direct the movements of his hands by the use of sight, in the readiness with which he is able to follow a moving object with his eyes, and most of all in the decrease in non-specific mass activity and its replacement by adaptive movements of local parts. Although he is still inclined to "wriggle all over" when he tries to do something, particularly if it is

something new, his wriggling is more likely to produce the desired result even though a good many unnecessary movements are involved.

Try the same experiment six months later. We now find the year-old baby creeping about with considerable agility, sitting alone with perfect balance and changing from the sitting position to the creeping position without hesitation or difficulty. He pulls himself to a stand by the help of a piece of furniture, walks with the aid of a supporting hand or the rails of his crib. At six months he could manipulate fairly good-sized objects, using his entire hands without very much independent finger movement; by nine or ten months, finger movements have advanced to the stage at which he can pick up tiny objects between his thumb and finger. Before the end of the first year the index finger is used alone for pointing, touching, and exploring objects in many ways. By this time, too, most children show some tendency to use one hand in preference to the other, though the difference is not very marked. Hand preference at this stage is, in fact, so slight that nearly all babies will be likely to grasp an object with the hand nearest it whenever there is a definite advantage of position; but if care is taken to offer an object exactly in the median line of the child's body so that neither hand is given any advantage over the other, it is found that as age advances more and more children come to reach with the right hand rather than with the left. (See Figure 29.) We have no way of knowing, at present, whether this general preference for the right hand is determined by some native process of maturation or whether it is the result of training. Undoubtedly most mothers tend to encourage children to use the right hand whether or not they are aware of doing so. Objects are put into the right hand more often than into the left; the right hand is more likely to be picked up and patted or stroked (as a result of the hand-shaking habits formed in ordinary adult inter-



Number tested	11	23	21	31	27	36	31	27	36	28	23	23	15	19	10	21
" accepted rt.	5	6	11	13	16	21	13	17	22	15	12	14	9	11	7	15
" " left	5	8	10	11	10	10	13	18	13	11	10	7	6	6	2	6

FIGURE 29

DEVELOPMENT OF RIGHT-HANDEDNESS IN INFANTS

(From H. S. Lippman, "Certain Behavior Responses in Early Infancy, *J. Genet. Psychol.*, 1927, 34: 424-440. Courtesy of Clark University Press.)

course). Some mothers from the beginning make a definite effort to train the child to be right-handed. They feel that since this is a right-handed world, with its machinery and its social customs adapted to right-handed people, the child who is right-handed has a distinct advantage over the one who is left-handed. It is possible, therefore, that hand preference is entirely a matter of early training, but the fact that right-handedness is the rule among practically all races of mankind makes it seem probable that some neurological factor in involved as well. However, whatever native features are involved cannot do more than establish a tendency, for children who appear to be "naturally" left-handed can, as we all know, be trained to use the right hand, though the process of training may be difficult. Whether or not it is desirable to do this is another matter, which we shall consider in a following chapter.

The average child learns to walk alone by the age of fourteen or fifteen months. Nearly all can do so by eighteen months. After the child has learned to walk, motor development is seen less in the appearance of "new" abilities than in the extension and improvement of earlier accomplishments. The major organizations of motor acts have been laid down, the basic motor patterns have been designed. From now on, although the baby's motor development will include the acquisition of many new skills, these skills will differ from those acquired earlier in several respects. They will vary more from child to child and will be more closely related to his individual experience, that is, the element of learning will be more conspicuous. They will be more narrowly related to particular situations and particular purposes. For example, some children learn to write while others do not, and whether or not writing is learned will depend not only upon ability but upon opportunity and experience. And writing is used in fewer situations than the basic skills of reaching, grasping, holding, and the coördi-

nation of eye and hand by which the movements of the pen are directed. The same thing is apparent in other motor skills gained after the period of infancy. Walking and running are basic skills acquired by all normal persons. They are used in an extremely wide variety of circumstances. But such specialized adaptations of these acts as dancing, walking a tight-rope, and skating are not universally learned and have a much narrower range of usefulness.

Does learning or maturation play a greater part in the development of the basic motor skills? The question cannot be answered with certainty, but there is some experimental evidence. Let us first see what light the behavior of the new-born baby can shed on the matter. We have seen that well-organized patterns of behavior which cannot possibly have been practised before birth appear immediately afterward. The pupils of the child's eyes cannot react to light where there is no light, yet they do so on the second day or earlier. The child cannot breathe where there is no air, yet breathing occurs immediately after birth. It is well that this is so, for if the new-born baby had to go through all the slow and toilsome stages of learning as we know it in order to be able to perform such necessary acts as breathing, eating, digesting, assimilating, and excreting, his chances of survival would be small. Fortunately this is not the case. At birth, or even before, all the neural mechanisms needed for performing these and other motor acts are completed. As soon as the occasion arises and the stimulus is given, the appropriate behavior pattern follows, complete in all its necessary details the first time it is tried. To be sure, the activity may not be quite as perfect, quite as efficiently performed on the first trial as it will be later on. Careful studies of the first eating reactions both of human beings and of animals have shown that, although from the very beginning the behavior is well enough coördinated to enable the baby to secure the food it needs, there is some improvement in efficiency with

practice. According to Breed * and to Bird,† when baby chicks are forcibly fed by hand and not allowed to peck for several days after hatching, their first performance on being allowed to peck at their food is little better than that of newly hatched chicks. The aim of one of these chicks is so inaccurate that he often misses the grain completely, and even if he succeeds in picking it up he may drop it again before he has succeeded in shifting it to the back of his mouth in order to swallow it. In the beginning, only about 15 per cent of the pecks are completely successful, but the percentage improves rapidly with practice.

Practice, however, is not the only factor determining success. As the chicks grow older, their pecking, even without practice, becomes somewhat more accurate; and when normal feeding is permitted the older chicks improve more rapidly than the younger ones, so that within a few days those for whom pecking was experimentally delayed reach the same level of efficiency as the ones who were fed naturally from the start. It looks as if maturation processes alone without any practice whatever were sufficient to bring the behavior pattern up to a degree of perfection that is sufficient to sustain life, but that after this point (which is normally attained before the time of hatching) has been reached, practice is needed in order to bring about the high degree of skilled coördination in aiming, striking, seizing, and swallowing the grain that is displayed by older chickens.

Although for obvious reasons experiments of this kind cannot be carried out with babies because of possible ill effects, careful observations of their early feeding reactions suggest that much the same thing is true. A normal full-term infant when put to the breast for the first time fumbles

* F. S. Breed, "Development of Certain Instincts and Habits in Chicks," *Behavior Monographs*, 1911, 1: 1-78.

† Charles Bird, "The Relative Importance of Maturation and Habit in the Development of an Instinct," *Journal of Genetic Psychology*, 1925, 32: 68-91.

about uncertainly, has some difficulty in adjusting the suckling movements to his rate of breathing, occasionally allows the milk to run out of his mouth without swallowing, and frequently permits the nipple to slip from his mouth and is unable to regain it without the help of the mother or nurse. In these "finer points" of suckling his lack of practice betrays itself clearly; nevertheless the basic mechanism is there. His table manners may be less polished, his feeding habits less efficient than they will become after five or six months of practice have been combined with further maturation, but in spite of awkwardness and uncertainty the complicated rhythmic movements of lips, tongue, cheeks, and throat are carried out with a degree of perfection that is amazing indeed when we compare it with the older person's first attempts at swimming, turning cartwheels, or learning to typewrite.

Occasionally an infant is born so far ahead of normal term that the suckling reaction has not yet developed. If the swallowing reflex has appeared, however, such infants may be kept alive by artificial feeding. An infant that I had opportunity to observe who was born two months before term had to be fed with a medicine-dropper for about two weeks. Even when the nipple was placed in the child's mouth, her lips failed to close and no attempt at suckling could be elicited. About two weeks after birth the response appeared very suddenly, and within twenty-four hours was sufficiently well established to permit giving up the artificial feeding entirely. The complete absence of the response at birth and its sudden appearance later without previous practice is very unlike the slow and gradual process of learning that we see in later life, but it is what we might expect to occur if the behavior were dependent on the completion of the growth of some neural mechanism by which it is controlled. We may liken it to the turning on of an electric light. All the necessary machinery is there, but until the

switch is turned and the wires brought into contact there is no light. This child's behavior at birth was in marked contrast to that of the normal full-term infant, of which the following account given by Stern * is an example: "On the evening of the day of birth the child audibly sucked his thumb, and also in the following night. When he was twenty-four hours old and first put to his mother's breast he quickly closed his lips on it and sucked away lustily, so that we several times noticed ten, six, thirteen consecutive sucking movements. Without any kind of hesitation, trial, or learning, the sucking instinct functioned in absolute perfection."

The difference in the behavior of these two infants at birth cannot be explained in terms of a difference in practice, but it can be readily accounted for if we assume that the suckling response involves the completion of a rather complex neurological pattern and that those parts of the act which take place first (grasping the nipple with rhythmical compression of the lips, tongue, and cheeks and indrawing of the breath alternating with relaxation and expulsion of the breath) are dependent upon neural structures that are the last in the series to become functionally complete. Under these conditions the act could not occur at all until it was ready to occur as a whole since the beginning elements are the last to be made ready.

It is known that in animals a number of rather complicated acts appear without previous practice. Avery † for example, was able, by means of X-ray photographs, to show that unborn guinea-pigs shortly before the time of normal delivery make no attempt to right themselves when the body of the mother is placed in such a position that the fetuses are upside down, but that they do so immediately

* Wm. Stern, *The Psychology of Early Childhood,* sixth edition, translated by Anna Barwell (New York: Henry Holt and Company, 1930).

† George T. Avery, "Responses of Fetal Guinea Pigs Prematurely Delivered," *Genet. Psychol. Monog.,* 1928, 3: 245-331.

and without difficulty if placed on their backs after artificial delivery a few hours later. Even more convincing are the experiments of Carmichael,* who divided a mass of frog's eggs into two parts, one of which was kept in plain water and the other in water containing chloretone, a drug which anesthetizes the developing animals so that they do not move within the egg but which has no effect upon their physical growth. After a time the eggs in both groups hatched as usual into tadpoles. Those in the plain water shortly began to swim, but the anesthetized group remained motionless. After the normal animals were swimming well, the others were removed to fresh water that did not contain any drug. Within a short time all began to swim, and in a few minutes they were swimming just as well as those that had been practising the art for some time. As soon as the effect of the anesthetic had worn off, the behavior appeared; it did not have to be learned. Salamander's eggs, treated in the same way, gave the same results.

Since it is obviously impossible to keep babies anesthetized until the time when they would normally begin to walk, we have no way of knowing whether or not they would do so without practice. Perhaps the nearest approach to this situation is to be found in an experiment carried out by Gesell.† A pair of identical twins (see Chapter III) were separated for a period of six weeks, just before their first birthday. During this time one twin was given fairly intensive practice for ten minutes daily in playing with one-inch cubes and for another ten minutes in climbing a short flight of steps. The experimenter who worked with the child made every effort to encourage and help her in these activ-

* L. Carmichael, "The Development of Behavior in Vertebrates Experimentally Removed from the Influence of External Stimulation," *Psychol. Rev.*, 1926, 33: 51-58.

————, "A Further Experimental Study of the Development of Behavior," *Psychol. Rev.*, 1928, 35: 253-260.

† Arnold Gesell and Helen Thompson, "Learning and Growth in Identical Infant Twins," *Genet. Psychol. Monog.*, 1929, 6, No. 1. Pp. 123.

ities. During the six weeks' training she made rapid progress, so much so that if there had been no way of checking up on the matter it might well have been thought that her behavior along these lines had been greatly accelerated by the training. The other twin was kept in an environment where there were no steps and no furniture low enough for her to climb upon. Her toys during this time were of the kind usually furnished to babies of her age except that there were no small blocks. The twins had been carefully tested at the beginning of the experiment and found to be alike in both types of ability. This was to be expected, since identical twins have the same heredity and up to the time training was begun these twins had also had equal opportunity to learn.

How did they compare at the end of the training period? In their handling of cubes both were decidedly more mature than they had been six weeks previously, but the extra practice given to one twin had not given her any advantage at all, so far as could be determined, over the child who had not touched a block during that time. Growth, not learning, had brought about all the improvement that had occurred. In the matter of stair-climbing, however, there was some difference. After one twin had had two weeks' training she did a little better than her sister who had had none. At the end of the six weeks' period the superiority of the trained twin was fairly marked, and this superiority was still evident after an additional week without further practice. But the untrained twin was then given a two-week period of training, at the end of which she did distinctly better than her twin had done three weeks earlier after six weeks of training. That is, two weeks' training plus three weeks' additional growth was more effective than six weeks' training at an earlier age. A week later both twins were tested again, neither having had any practice in the meantime. This time their performance was equal. Putting all

the evidence together, Gesell comes to the conclusion that six weeks' training in stair-climbing did not make the child able to climb stairs any better than she would have done one or two weeks later with no practice at all, and that even this slight advantage was only temporary.

Shall we then conclude that maturation alone will give children all the motor skill they need and that training has no effect? So far as the basic motor acts acquired by all normal persons are concerned, it may well be that growth alone will establish all the neural connections necessary, and that there is little we can do to hasten the process. We have seen that the neurological foundation for many acts of behavior is laid down before birth when no practice is possible, yet these activities appear in sufficiently perfected form immediately after birth. We know, too, that considerable maturation occurs in the nervous system after birth, particularly during the first year. It would be strange indeed if this further growth were to be unaccompanied by changes in behavior that appear independently of any formal training. Probably if all were known it would be found that certain basic motor acts are almost wholly dependent upon the normal growth and maturation of the nervous system. These acts would be most likely to appear at the ages when the nervous system is growing most rapidly, that is, early in life. They would be acquired by all normal individuals, though not necessarily at exactly the same age, since the rate of growth in the nervous system will vary from one person to another. Neither does it follow that all persons will eventually become equally skilled in the performance of these acts, since the neural patterns may be more perfectly organized in some cases than in others. Moreover, even though the basic pattern of an act is determined by maturation, its finer details will probably be improved by practice, just as we have already seen is the case in the feeding reactions of chickens. In addition to the

neural factors, the differences in bodily form and musculature that exist from one person to another have something to do with their differences in motor skill. If all other factors are equal, the person with long, flexible fingers finds it easier to learn to play the piano or run a typewriter than the one whose fingers are short and stubby and whose joints are stiff.

Finally, we must not lose sight of the fact that any formal training that can be given the very young child fades into insignificance in comparison with the enormous amount of incidental practice that he gains in the course of his everyday activities. From morning to night he is busily exploring the world about him. Every new object he sees is exploited in a dozen different ways and by the aid of as many senses as he can bring to bear on it. It is felt, tasted, hammered, pushed about, dropped and picked up again, turned over and over, looked at from every angle, listened to, dragged about, and stuck into every available crevice, and its possibilities as a noise-maker, a scratching or engraving tool, a lever, and a poker are tried out on as many different objects as possible, not forgetting the parlor furniture. Not only does this incessant practice bring about rapid improvement in the skills whose basic patterns are already present, but it also provides the personal experience that gives form and meaning to the sensory impressions that accompany all the child's activities. Objects lose their impersonal character, if, indeed, they existed as objects for the child before experience had brought them into some kind of personal relationship to him, which seems rather doubtful. The cup from which he drinks his morning milk is not simply a visual pattern of lights and shades or something that stimulates his organs of touch but is also a *desired object,* a giver of pleasure, a satisfier of his bodily needs. It is not a thing completely external to himself but something that has a very intimate relationship to himself. It is this personal

relationship, this emotional connotation giving it meaning, that makes it stand out from all the rest of his surroundings as something special and different. Before we can fairly understand how a child learns, how his reactions to the people and things about him are determined, what it is that guides his activities, causing him to seek this and avoid that, we must first of all observe the development of his emotional reactions. We must see how his likes and dislikes are established and how the more specific emotions such as fear and anger change and develop with age. We shall also find it useful to consider how emotional growth can be directed and how undesirable emotional reactions in ourselves and others can best be brought under control and guided into happier channels.

Chapter IX

EMOTIONAL BEHAVIOR IN INFANCY

What is meant by a "conditioned response"? How did the term originate?

What are some of the most important principles governing the establishment of a conditioned response?

How accurately can we identify emotions in others? Why is it often hard to do so?

What is meant by the "evolutionary theory of emotional behavior"?

What is the James-Lange theory of emotion? What are some of the main objections that have been made to it?

What are moods, and how are they related to emotion?

What parts of the brain are most actively concerned in emotion and its control?

How is the principle of development by differentiation shown in the changes in emotional behavior that occur during infancy?

How can undue fear or anger best be controlled or prevented in young children?

Why are the emotional experiences of children so important for their future development?

The Modification of Emotional Reactions

In Chapter VII we pointed out the association between the changes that occur in a child's emotional state in the course of a particular experience and the changes that take

place in his behavior on subsequent occasions when similar conditions arise. The baby tends, or (as we say) he *learns*, to repeat the acts by which he attained a greater state of satisfaction and to avoid those that brought pain or dissatisfaction. Thus his emotional responses are closely bound up with his learning.

In the beginning the new-born baby shows no clear evidence of responding in an emotional manner to anything except his own physiological states of comfort or discomfort. He cries and struggles when he is in pain or fatigued, but he is indifferent to scolding, threats, the sight of strange persons or objects, and many other things that later on will arouse him to anger or fear. Likewise, many situations that had no positive attraction for him in the beginning will become strong incentives for him later on when he has had more experience with them. As a result of experience practically everything comes to have at least a mildly affective meaning for him. Not only do his emotions direct his learning, but the particular kind of emotion that he experiences in any given situation is in large measure learned, that is, it is determined by earlier experience in similar situations. The process by which new emotional states and the behavior that is appropriate to them become attached to situations that formerly failed to arouse these emotions is commonly known as "conditioning" because of its close resemblance to the results of the animal experimentation carried out under that name by the Russian physiologist Pavlov and his associates. We shall understand the human situation more easily if we turn first to the work that has been done with animals.

Pavlov's first work on "conditioning" was carried out about the beginning of the present century. In connection with certain experiments on the rôle of the salivary glands in digestion he introduced a little tube into the duct by which the saliva from one of the glands finds its way into

the mouth and brought the other end of the tube out through the dog's cheek so that the saliva would pass out through the tube into a vessel where the amount could easily be measured. Now the amount of saliva secreted by any animal is directly stimulated by the presence of food in the mouth. But Pavlov noticed that not only the actual presence of food in the mouth but all sorts of other conditions that the dog had learned to connect with his feeding time would increase the flow of saliva. The sight of the attendant who usually fed him or the sound of his footsteps coming down the row of kennels at feeding time would do so. To this increase in salivary flow Pavlov applied the name of "conditioned reflex" because it takes place without conscious intent and occurs only under certain "conditions" that have taken on meaning for the animal as a result of experience.

Although Pavlov placed particular stress upon the salivary secretion as a measure of the extent of "conditioning," other motor reactions occurred along with it that are equally significant though less easily measured. The dog's head and eyes would turn toward the door by which the attendant usually entered. If free to do so, he would be likely to run toward the door or to the side of his pen where he was accustomed to be fed; he would begin to wag his tail, perhaps bark and whine and jump about. So, although we speak of the salivary secretion as a "conditioned reflex," we must not lose sight of the fact that the secretion of saliva is only a single element in a complex behavior pattern. Here we have an important difference between the conditioned reflex and the simple reflex that is set in action by a "natural" stimulus. In the latter, the association between stimulus and response is prompt and direct and fairly well localized. A light thrown into the eye causes the pupil to contract, but unless it is strong enough to cause discomfort it does not arouse much activity in other parts of the

body. A tap on the patellar tendon causes the foot to jerk forward and upward, but other responses are few and inconspicuous. Gastric juice is secreted when food enters the stomach, saliva when food is placed in the mouth without warning, but these responses are pretty well confined to the part of the body stimulated unless disturbing features of some kind occur as supplementary stimuli. Really the term *reflex,* which in common psychological usage refers to a relatively simple and highly localized act, should hardly be applied to the conditioned response, which as a rule involves widespread activity in the entire organism. Ordinary reflexes can and do occur in animals whose cerebral hemispheres have been removed, but conditioned responses, including the so-called "reflex" elements such as the secretion of saliva, cannot be established unless the subject's brain is in good working order. It looks as if the establishment of a conditioned response is in some way dependent upon what, in previous sections, we have called the growth of meaning: that is, the interpretation of one kind of sensory situation in terms of other sensory elements, particularly the feelings and emotions * that have previously been connected with it. Looked at in this way, we may say that the conditioned response is nothing more than a response to a meaning; a meaning, to be sure, of which we may not at

* The terms *feeling* and *emotion* are used here in much the same sense as they are used in everyday speech, with no attempt to draw the fine distinctions between them that have been made by some psychologists. As used here the term *feeling* refers wholly to the subjective side of experience, the part of organic activity that goes on within the individual and claims his attention for longer or shorter periods. It is the organism's awareness of its own condition, particularly with reference to the satisfactoriness or unsatisfactoriness of that condition. An *emotion* is more than a feeling. It is a drive to do something—a something, moreover, that will bring about a change in the relationship of the organism to its environment. An emotion is outwardly directed. It is the starting point of overt action, though it is true that sometimes the action may be inhibited before it has reached the muscles where it can be observed by other people. Feeling, on the other hand, is inwardly directed. It does not lead directly to action except when, as often happens, it passes over into emotion.

the moment be clearly aware, and which may become changed as a result of later experience. But let us go back to Pavlov's experiments.

After noting the appearance of the conditioned salivary response in connection with everyday events in the routine of the laboratory, Pavlov set out to investigate it under more rigidly controlled conditions. A hungry dog was fastened loosely in a kind of harness that would prevent him from moving around very much. In order to make sure that no distracting conditions would occur that might interfere with the progress of the experiment or make it uncertain to what stimulus the dog was responding, he was placed on a table in a sound-proof room with constant lighting arrangements and with the experimenter concealed from his sight. After he had become quiet and at ease an electric bell was rung, and after it had been ringing for a certain length of time, always kept the same in a given experiment, the dog was given food, which of course would start the saliva to flowing. He was not, however, given enough food to satisfy his hunger. After a few minutes the bell was rung again, and after the same length of time as before he was again given food. After this had been repeated a number of times it was noted that when the bell started to ring the dog would turn and look toward the source of food, perhaps take a step or two in that direction if the harness permitted, and that saliva would begin to flow out of the tube *before* the food was given. You should note, however, that in all this there is nothing essentially different from the behavior of the house dog who comes running to the kitchen door when his name is called at feeding time, or the watering of your own mouth at the sight of a picture or on reading the description of an appetizing dish. Pavlov's experiments, however, through more exact control of conditions, enabled him to study the conditioned response more precisely than could otherwise be

done and in this way to formulate certain rules about the way it is established and how it may be extinguished. Among the most important of these rules are the following:

1. In order to establish a conditioned response the artificial stimulus must precede the natural stimulus.* The dog will not learn to come for food if he is called *after* the food has been given; he will pay no attention to a bell that starts to ring while he is eating.

2. The conditioned response becomes more closely tied up to the exact stimulus as training proceeds. Discrimination increases with practice. In the early stages of training the response may appear at almost any kind of a stimulus that resembles the one used for conditioning. If the sound of a particular bell has been used as the conditioned stimulus, the response at first may appear when almost any kind of a bell is rung; but if the same bell continues to be used, the animal will soon learn to discriminate so exactly that this bell and no other will arouse the response. Discrimination takes places more rapidly if the animal is accustomed to hearing other bells without receiving food, so that the difference in the auditory impressions comes to take on meaning for him.

3. As training proceeds, the appearance of the response gradually becomes adjusted to the interval usually occurring before the natural stimulus is given. If food is not given until thirty seconds after the bell begins to ring, the flow of saliva occurs later and later on successive trials until it finally reaches a point where it will begin at almost exactly thirty seconds after the ringing of the bell and not before. We see something similar to this in children whose parents

* Although this statement is in the main true, it has been found that with continued training "backward conditioning"—i.e., the establishment of a conditioned response when the natural stimulus is given before the conditioned stimulus—is sometimes possible. Most experiments of this kind, however, have shown successful results with only a small percentage of cases. For the majority of the subjects no conditioning takes place.

are in the habit of calling them several times when a disagreeable task is to be performed before proceeding to serious measures. Although it is doubtful whether they stop to reason the matter out, even little children learn to gage the period within which delay is safe with surprising accuracy.

4. The conditioned response, like other learned reactions, tends to disappear after a period of disuse, but that some effect of the earlier learning lingers is shown by the fact that the response can be reëstablished with fewer trials than were at first necessary. It will disappear more rapidly if the conditioned stimulus is given frequently during the interval without being followed by the natural stimulus, e.g., if the bell is often rung in the dog's hearing without giving any food. This process of negative conditioning seems to be essentially similar to that of the original conditioning with this difference, that where the conditioned stimulus was first a signal for the dog to respond by behavior suitable to the receiving of food it has now become a signal for him not to respond or to respond in other ways. This is not at all the same state of affairs as existed previous to training when the bell was an indifferent occurrence, not a signal of any kind. It is an active, not a passive state. If the animal is distracted by some other stimulus just after the original conditioned stimulus is given, the old response is likely to occur again just as if the habit had never been broken up. Or if an animal who has been conditioned to wait for a time before responding is distracted during the waiting period, the response is likely to occur at once. Most of us are familiar with similar occurrences in our own lives. We have learned or "become conditioned" to waking at a particular time under a daylight-saving schedule. The first of October arrives, we go back to standard time and rejoice in the extra hour of morning sleep. But for some time, although we may sleep out the allotted time if everything

remains quiet, a slight noise occurring near the former rising hour will be enough to waken us. The Middle Westerner who, as the result of a prolonged residence in New England, has acquired a Boston accent is more than likely to revert to the broad *r* of his childhood under conditions of unusual strain or excitement. The force of earlier habit is never so strong as when something happens that throws us off our guard.

There is little doubt that the greater part of the learning of infancy is of the conditioned response type. Now it is very difficult indeed to establish a conditioned response when the response to the natural (sometimes called the "biologically adequate") stimulus is unaccompanied by any pronounced feeling of pleasure or displeasure, satisfaction or dissatisfaction, getting what one wants or failing to get it. When the natural stimulus results in a strong emotion such as marked fear or a very pronounced feeling of pain or pleasure, one or two experiences may be enough to establish the conditioned reaction to some accompanying factor. If the affective state accompanying the natural stimulus is comparatively mild, many more trials will usually be required to bring about the conditioned response and it may not be possible to elicit the response at all.

Watson * has given us a vivid description of the manner in which a conditioned fear response was built up in a healthy child less than one year of age. The child was first shown a white rat. He reached for it repeatedly, showing no signs of fear. Evidently the rat itself, in the absence of any unpleasant associations with it, was not a fear-provoking object. Now the rat was shown again, but this time, just as the baby reached for it, an iron bar just behind him was struck, making a loud bang. Even the new-born baby will frequently start and begin to cry when

* J. B. Watson and R. R. Watson, "Studies in Infant Psychology," *Scient. Mo.*, 1921, 13: 493-515.

such a stimulus is given, and by the time the child is a few months old this response is likely to be accompanied by more finely differentiated reactions of the kind that we call fear. He starts more violently, draws back, perhaps tries to escape or clings to some one for protection, and his crying takes on a sharper and shriller note. In part these reactions are learned by experience, but it is likely that further maturation also has something to do with it.

When the bar was struck, the child reacted in much the way described above. The hand with which he was reaching for the rat was jerked suddenly back, he started violently, screamed, and tried to crawl away. A week later when the rat was shown again, mild evidences of fear or at least of avoidance appeared, and after two or three reinforcements by repeating the original combination of rat—loud sound, the mere sight of the rat was enough to provoke very marked evidences of fear. Shortly afterward it was found that the fear reaction had spread to include all sorts of furry or fuzzy objects—a piece of cotton wool, a fur coat, a Santa Claus mask. Carefully conducted experiments have shown that under the proper circumstances new conditioned responses may be built up from reactions which themselves have arisen through conditioning, though not (as a rule) so easily. Thus not only does the conditioned response grow out of the natural response, but one conditioned response may give rise to another and so the circle grows.

It takes but little consideration to convince one that many of the emotional reactions which we experience in everyday life are not based on any objective facts in the situation itself but are purely matters of association. Some one says, "I can't bear to eat spaghetti because it reminds me of white worms." Another becomes illogically irritated without knowing why whenever he is forced to deal with a certain person who, to the rest of the world, seems quite inoffensive. Another has an unreasoning aversion for cats. An elderly

woman of my acquaintance had at about the age of sixteen lost her mother, to whom she was deeply devoted. In the community where she was then living, the wearing of black on all occasions after the death of a near relative was practically obligatory. To the end of her life, this woman's dislike for black clothing was so strong that by mutual consent the members of her family carefully refrained from wearing it in her presence. After the woman's death, her children, almost without exception, found that the wearing of black was very distasteful to them. Although there was no longer any reason why they should not wear it, they rarely or never did so. Here we have a case of a conditioned emotional reaction that not only persisted throughout the lifetime of the person in whom it was originally built up but was strong enough to serve as a primary conditioning factor in the lives of others.

How Emotions Are Identified

Although it is very hard, as we have seen, to tell from the behavior of a crying baby two weeks old whether he is afraid or angry, hungry or suffering from stomach-ache, as he grows older his emotional behavior soon begins to take on definite patterns that enable us to classify his reactions with a fair degree of assurance. (See Figure 30.) It is unnecessary here to give elaborate descriptions of the differences between the way children or older people behave when they are angry and the way they behave when frightened, jealous, happy, sad, expectant, resentful, or disappointed. Every one has observed these reactions. It is true that the behavior shown under such conditions is not so fixed and invariable that no one can mistake it. Many experiments have been carried out which show that people often disagree when they attempt to decide just what emotion some one else is experiencing, particularly when they are asked to make their judgments on the basis of some

limited part of the whole behavior pattern such as a single photograph—a method that has been used in a number of experiments. Moreover, as people grow older they learn to be fairly clever at concealing their feelings and feigning others when social custom makes it desirable for them to do so. Little children display their emotions more openly, and for this reason it is often easier to judge their real feelings than is the case with adults. (See Figure 31.)

Even though we sometimes make mistakes, upon the whole we are able to tell what emotions our friends are experiencing with a great deal better than chance success. Although people have their own individual ways of showing their feelings which differ somewhat from one person to another, there is still a good deal of similarity in the emotional patterns shown by people of all ages and races.

This general similarity of emotional pattern has aroused much discussion during the past half-century. In 1872 Darwin * and Spencer † simultaneously expressed the point of view that the emotional behavior of human beings has an evolutionary origin, and that many of the apparently unserviceable acts shown under strong emotion are merely survivals of actions that had a useful function in a more primitive state of existence. For example, the uncovering of the canine teeth so often seen in anger or sneering was said to be a survival from the time when our prehuman ancestors did much of their fighting with their teeth. Frowning is explained as a residual effect of an action originally useful in shielding the eyes from the direct rays of the sun during fighting when clear vision is most essential. Certain other forms of emotional expression Darwin was inclined to trace back to the infancy of the individual rather than the infancy of the race. Shaking the head as a sign of denial

* Charles Darwin, *The Expression of the Emotions in Man and Animals* (London: John Murray, 1872).

† Herbert Spencer, *Principles of Psychology*, Vol. II, second edition (1872).

FIGURE 30

DIFFERENTIATION OF EMOTIONAL BEHAVIOR WITH ADVANCING AGE

A. The baby is certainly unhappy but it is hard to say whether he is hurt, angry, or afraid. B The child of two shows a more distinct pattern of emotional behavior. Even from the single photograph one can be fairly certain that anger, resentment, or disappointment is present

(Courtesy of *The Parents' Magazine*. Photographs by Doris E. Wright.)

or unwillingness is an act that appears early in most children and is continued throughout life. Darwin ascribed this to the survival of a habit formed during the nursing period when turning the head to the side was the natural way of rejecting unwanted food.

Many other examples might be cited, but the above will serve as illustrations. They are not always convincing. While the relationship to infantile experience seems more in keeping with known facts than the arguments from the history of the race, neither explanation seems adequate to account for all that takes place.

In opposition to the point of view which stresses the *similarities* in the emotional behavior of different persons and considers that these reactions are for the most part native and unlearned, without, however, denying that they may be to some extent modified by experience and inhibited or feigned at the will of the individual, is a more modern idea that emphasizes the *differences* in the way the same emotions are shown by people of widely different social experience and ascribes the origin of these behavior patterns chiefly to early imitation by children of the behavior of others, together with their tendency to repeat actions that bring them approval or indulgence and to refrain from those of which the results are unpleasant. Emotional behavior, according to this point of view, is almost wholly learned during the lifetime of the individual. The particular patterns by which fear, anger, jealousy, and so on are expressed are not the native results of continuing maturation but are acquired by experience.

As in many similar points of controversy, the truth probably lies somewhere between the two extremes. It is a considerable strain upon one's credulity to accept the idea that the crying which appears as an accompaniment of pain or discomfort within the first hour of life has been learned either by imitation or through reward and punishment,

though most of us are agreed that the child who finds that crying is a means of getting attention under almost any circumstances soon learns to resort to crying in situations in which the one who has found it a less effective weapon would remain quiet. And if crying as a form of emotional behavior can occur without training, there seems to be no logical reason why frowning, kicking, striking, running away, smiling, sneering, stamping, and so on throughout the long list of reactions that appear one after another may not also be the unlearned results of maturation,* although, as we have seen in the discussion of conditioning, their occurrence under particular circumstances may be determined by experience. As age advances, imitation and social custom undoubtedly play an increasingly important part in fixing their exact pattern. An important sign of emotional maturation is to be found in the bringing of these unlearned emotional reactions under voluntary control.

We are able to identify emotions in others, then, on the basis of certain patterns of behavior which are their normal accompaniments and which differ somewhat from one emotion to another. Like most of the other basic behavior patterns, the major features of emotional reaction are the unlearned products of maturation. At birth only the broad outlines of these patterns are present, but as age advances finer details emerge. Long before the end of childhood, the external evidences of most, if not all, of the emotions experienced by the adult appear in recognizable form. With

* Further evidence of the unlearned character of many of the physical signs by which emotions are recognized in others is to be found in the behavior of children who are cut off from many of the ordinary opportunities of learning by reason of sensory defects. I have described the behavior of one such child, a little girl of ten who had been totally blind and deaf from birth. Although imitation of the behavior of others was out of the question in her case, nevertheless her reactions under conditions that would be expected to arouse such emotions as fear, anger, or pleasure showed amazing fidelity to the classic descriptions of emotional behavior. Cf. "Expression of the Emotions in a Deaf-blind Child," *J. Abnorm. and Soc. Psychol.*, 1932, 27: 428-433.

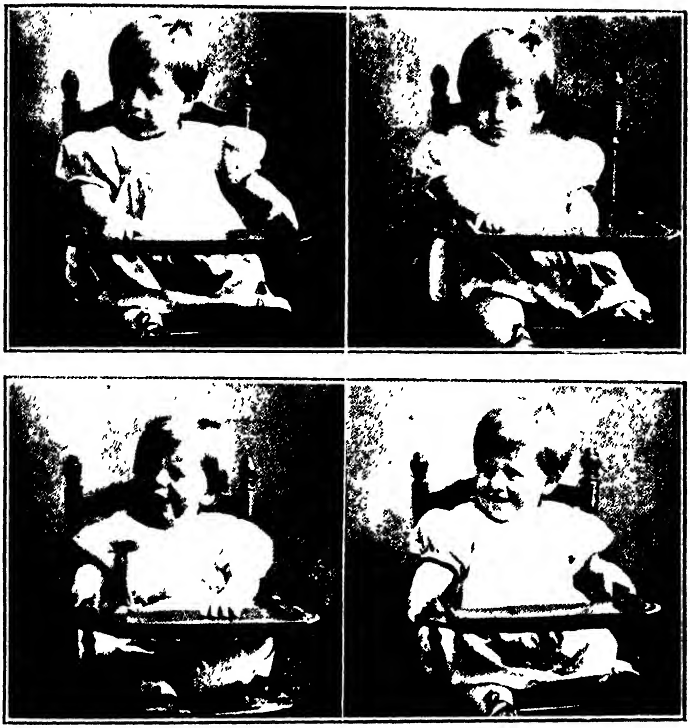


FIGURE 31

EXPRESSION OF THE EMOTIONS IN AN INFANT OF TEN MONTHS

The pictures shown above are reproduced by permission of the publishers from "Die Entwicklung der Gemutsbewegungen im ersten Lebensjahre" by Martin Buchner, Beitrage zur Kinderforschung und Heilerziehung, 1909, 60; 19. The author interprets the child's emotions and describes the situations which gave rise to the behavior as follows:

A. Astonishment (with ocular attention). A bright-colored new toy clown was shown to him.

B. Dissatisfaction (with slight obstinacy). I had taken him up in my arms and then put him back in the chair. He wanted to come to my arms again.

C. Crying. He was tired of sitting and wanted to come out of the high chair into my arms. (This is a later stage in the situation described under B.)

D. Satisfaction and affection. He was looking at his mother who talked to him in a friendly manner.

increasing maturity these external signs are brought more and more under the control of the individual, and as a result many of the more primitive forms of emotional behavior are likely to be inhibited or modified, which makes them harder to identify.

How do we recognize and identify our own emotions? The question seems rather absurd on the face of it, but when one stops to think it is not easy to answer. You "know" when you are angry, and it doesn't feel a bit like being afraid or pleased or sad. But how do you know?

The James-Lange Theory of Emotions

During the last quarter of the nineteenth century, William James in America and Carl Lange in Denmark independently formulated a theory of emotion that was designed to answer the question just asked. Briefly stated, the theory is this. What we feel in emotion is nothing more than the sensations coming in from all parts of the body as a result of the muscular and glandular actions which are the observable accompaniments of the emotion. This is just the reverse of the way most people think of it. Most of us would say that we run because we are frightened, we strike because we are angry, we cry because we are hurt or sad. The James-Lange theory puts it the other way around. We are frightened because we run (and because at the same time our hearts beat more quickly, we breathe faster, digestion is stopped, and the activity of other internal organs is modified in various ways). We are angry because we strike, sad because we cry. The emotion, then, is nothing more than a complex of bodily sensations, chiefly those received from the proprioceptors and interoceptors, and it is this latter fact that gives it its peculiar quality of personal "belongingness." As we saw in an earlier chapter, the untrained person is likely to confuse a stimulus with the sensation it arouses, to make the "stimulus error." He refers redness to the

object at which he is looking, not to the response of the sense-organs in the retina; cold to the object that touches his skin, not to the responses of the cold spots. But no one makes the stimulus error when the feelings and emotions are concerned. Anger is not out there, it is in me. *I* am afraid, or sad, or disappointed.

According to the James-Lange theory all strong emotions have this in common, that they result from an unusually strong or widespread arousal of the receptors, and so they all involve a feeling of excitement, of being stirred up and active. Each emotion has its own peculiar pattern of sensations, depending upon which set of receptors is most active, and by this we are able to distinguish between them. Some emotions feel a good deal alike, others very different, depending upon whether they are dependent upon sensations coming from much the same parts of the body or from widely separated parts.

Although this theory is commonly accredited to James and Lange, since they were the first of the modern psychologists to formulate it clearly, its origin goes back much further. The idea is suggested in the writing of Aristotle and Plato; St. Thomas Aquinas states that the bodily feelings are an essential part of emotion, though he is not, apparently, willing to assign them the entire rôle; Descartes * in 1646 and Malebranche † in 1672 stated the theory almost, if not quite, as explicitly as either James or Lange, and it is given in more or less detail in the writings of many of the earlier philosophers and physiologists. Whether or not it is true (and, as we shall see, it probably is only a part of the truth), it is nevertheless a theory with which every student of psychology should be acquainted. Few ideas have excited more thought-provoking discussion and criticism or stimulated more brilliant experiments than has this one. Through

* *Sur les passions de l'âme.*
† *De la recherche de la vérité.*

these experiments another link has been welded in the chain that unites psychology to physiology, a union from which much of our future knowledge seems likely to come.

We all know that during profound emotion there are certain bodily changes in posture and in facial expression, vasomotor changes such as flushing or growing pale, bodily tremors, changes in breathing and heart rate, sweating, and so on through a long list of symptoms that can be directly perceived by the subject himself or by others. Physiology has added to the list a number of other symptoms, less easily seen but perhaps even more important, since they cannot be so easily controlled. (See Chapter VII.) There can be no denying that bodily states normally accompany the internal feelings that we call emotion. The question raised by the James-Lange theory is, which comes first? And since their occurrence is so close together in point of time that no one can determine the order by direct observation, we are obliged to attack the problem in another way. Can the bodily states appropriate to an emotion be aroused without any feeling of emotion? Can people or animals who have no bodily sensations—who are internally anesthetic—experience emotion? Are emotions that "feel" different to the subject—for example, anger and fear—always distinguishable from each other by consistent and recognizable differences in the accompanying bodily states? Obviously, an emotion must be something more than an awareness of, or a response to, bodily sensations if it can occur equally well when these sensations are absent; and the bodily states cannot be wholly dependent upon the emotions if they can be aroused by other means.

What does common observation tell us? Not as much as we might at first think, for although it is entirely possible to assume the facial expression, the bodily posture, and the tonal inflections appropriate to almost any emotion, we cannot control the activities of our viscera, and the absence

of the appropriate visceral sensations may explain why we can laugh without feeling joy, run away without feeling fear, or engage in a wrestling or boxing match without feeling anger. Conversely, the person who remains outwardly calm during moments of intense emotional stress may owe his emotional feelings entirely to visceral reactions that the observer cannot see.

All this seems to take for granted that the sensations we receive from our viscera are fairly pronounced and definite. Contrary to popular opinion, which assumes that the inside of the body is more keenly sensitive than the outside, the viscera have relatively few sensory nerve-endings. "We are unaware," says Cannon, "of the contractions and relaxations of the stomach and intestines during digestion, of the rubbing of the stomach against the diaphragm, of the squeezing motions of the spleen, of the processes in the liver—only after long search have we learned what is occurring in these organs. Surgeons have found that the alimentary tract can be cut, torn, crushed, or burned in operations on the unanesthetized human subject without evoking any feeling of discomfort. We can feel the thumping of the heart because it presses against the chest wall, we can also feel the throbbing of blood vessels because they pass through tissues well supplied with sensory nerves, and we may have abdominal pains but apparently because there are pulls on the parietal peritoneum. Normally the visceral processes are extraordinarily undemonstrative." *

Another thing that makes it hard to account for emotional experience in terms of visceral sensations is the fact that the organic changes on which these sensations depend take place so slowly. Except for the heart, which is modified striate muscle, the responding tissues of the viscera are composed only of smooth muscle cells. We are likely to think of

* W. B. Cannon, *Bodily Changes in Pain, Hunger, Fear and Rage*, second edition revised (New York: D. Appleton and Company, 1929).

muscular response in terms of what we are accustomed to seeing in the external muscles, where the latent time is usually less than a thousandth of a second. But smooth muscle is far more sluggish. Its latent time has been variously stated, but is probably not much less than a second and some investigators report much higher figures. Emotional reactions of the kind that an outsider can observe take place in a time so much shorter than this that it is hard to see how the visceral changes can be directly responsible for them.

Another line of evidence comes from operations performed on animals to see whether or not emotional behavior would persist if organic sensations were prevented from reaching the brain. Sherrington transected the spinal cord and the vagus nerve of a dog said to have a markedly emotional temperament. This operation destroyed all connection of the brain with the heart, lungs, stomach, bowels, liver, and all other abdominal organs, but her emotional behavior was unchanged. "Her anger, her joy, her disgust, and when provocation arose, her fear remained as evident as ever." * Cannon and his associates went even further. They removed the entire sympathetic division of the autonomic nervous system in cats. As a result of this operation not only the sensations arising from organic states but the organic activities themselves that are supposed to be active in strong excitement were abolished. But if a dog was brought into the room and allowed to bark at one of these cats, the cat showed all the usual signs of excitement and rage. It would hiss, growl, draw back its ears, try to strike at the dog with its claws. Although some people have raised the objection that this is no test because we have no way of knowing whether the cats *felt* angry or not, there is no question whatever about the way they *acted*. In the absence of contrary evidence, it is surely more reasonable to suppose that

* *Proceedings of the Royal Society of London,* LXVI (1900), 397.

when the external parts of the behavior remained the same the internal components were also unchanged than it is to assume that the external parts of the reaction would occur in the absence of the internal phases which are their normal starting points.

Cannon * has also provided us with an answer to our third question. Careful study of the organic and glandular reactions during different types of emotion has failed to reveal any differences between the organic states in emotions that are "felt" as different *as long as these states are activated by the same division of the autonomic nervous system*. Thus, although pain, hunger, fear, and rage, all of which are associated with the action of the sympathetic division, seem very different to the person who is experiencing them, the visceral reactions appear to be the same for all.

Finally, emotion does not of necessity occur in connection with visceral activity. Adrenalin † (see pp. 148-149), for example, can be administered artificially, and when this is done the same organic changes take place as those which normally occur under the action of the sympathetic nerves. Subjects to whom adrenalin is given often report that they feel keyed up, "as if" something were going to happen, or even "as if" they were going to be angry or afraid. But giving adrenalin rarely, if ever, makes them angry or afraid or produces any of the other emotions that are normally associated with the physiological states induced by a natural secretion of the hormone itself. All that commonly occurs is recognition that their physiological sensations resemble those felt previously under different conditions. Except for one thing, the situation is much the same as when we say, "That man makes me think of Mr. Jones" or "These cookies taste like the ones mother used to make."

* *Op. cit.*

† The term *adrenalin* is commonly applied to the commercial product.

Moods

The exception noted in the last sentence is this: Many subjects who have been given adrenalin do appear to be thrown into a state which predisposes them toward a display of anger, fear, or other emotions of the excitatory group on relatively small provocation. Such a state of predisposition toward one kind of emotional reaction rather than another we call a *mood.* Moods are of many kinds. We have joyful moods, irritable moods, contented moods. As we have just seen, a physiological condition may be responsible for a mood. Everyday life provides us with many similar examples. Hunger, as we all know, is likely to make one irritable. Goodenough,* working with children, and Gates,† working with college students, have shown that the frequency of anger increases steadily with the length of time since the last meal. (See Figure 32.) Likewise indigestion, constipation, or other bodily disturbances predispose to anger, i.e., create an irritable mood, while good digestion promotes cheerfulness and content.

Not only do moods sway the balance in favor of certain types of emotion, but the arousal of emotion, particularly if it occurs repeatedly, frequently leaves an after-effect in the form of a mood. You get up in the morning feeling particularly cheerful. At breakfast some one spills coffee on your suit, necessitating a trip to the cleaners. You arrive at the corner just in time to see the street-car leave and have to wait fifteen minutes for the next one. As you are entering it, you collide with a fat man who first steps heavily on your toe and then wants to know why you can't look where you are going. The chances are that by the time you reach the office your original good temper will have been

* F. L. Goodenough, *Anger in Young Children* (Minneapolis: University of Minnesota Press, 1931).

† G. S. Gates, "An Observational Study of Anger," *J. of Exper. Psychol.*, 1926, 9: 325-336.

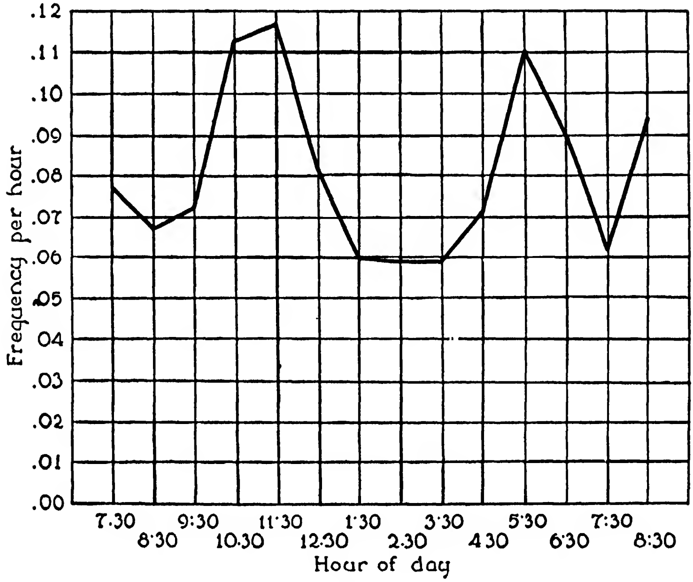


FIGURE 32

DIURNAL VARIATIONS IN FREQUENCY OF OUTBURSTS OF ANGER AMONG YOUNG CHILDREN

(From *Anger in Young Children* by F. L. Goodenough. Courtesy of University of Minnesota Press.)

entirely dissipated and your happy mood changed to one of irritability in which even a slight annoyance will precipitate a storm.

A mood, then, is not an emotion but a state of readiness, a "set" toward some particular kind of emotional reaction. Since moods may be induced either by physiological factors or remain as aftermaths of emotional episodes (in which physiological factors are involved), it is very possible that if all were known it would be found that moods always have a physiological basis of some kind, even though we are not at present always able to determine in what this factor consists.

Emotion as a Function of Primitive Brain Centers

If emotion is more than a mood, if it is not merely the perception of organic sensations as James and Lange thought it to be, what gives it its peculiar qualities of feeling and action? On one thing we are all agreed, that emotion seems to be something that comes of itself, that in its internal or "felt" aspects is far less subject to control than most forms of mental activity, although we can and do learn to suppress many of its external components. Emotion, moreover, differs from simple sensation in that it is always a response to a meaning and, as is to be expected, these responses become more varied and are attached to a wider range of situations as meaning grows. Emotion is an impulse to activity, a drive toward an end. But this end, it must be remembered, may not be clearly sensed; and the emotion itself, in the absence of thought, provides only a very primitive behavior pattern as an aid toward accomplishment. You see a bear. You are frightened. You run. Where? Emotion does not tell you. Its only counsel is to get away from the bear. The only action pattern it prompts is the primitive one of flight. The only aid it can provide is a physiological adjustment of the bodily processes that give strength to flight. There is a prompt neural discharge downward to the sympathetic nervous system, which goes into action at once. Adrenin is poured forth in increased quantities; sugar that has been stored in the liver and muscles for just such times of need is released into the blood stream; the breath comes faster, the heart beats more quickly, food and oxygen are brought to the muscles in greater quantities and at shorter intervals. All this is, as it must be, automatic and involuntary. The bear would surely catch you before you had time to think of all these things. And so far human intelligence has played but a small part. When emotion has free rein, rats, dogs, cattle, and men behave about as nearly alike as their physical

structures permit. Indeed, it was the recognition of the essential similarity in the emotional manifestations of man and animals that led Darwin * to extend his evolutionary theories to include mind, a theory that made animal psychology necessary and that in other ways has had a tremendous influence upon modern psychological thought.

Why this resemblance? Physiologists as well as psychologists and anthropologists have asked themselves the question. They noted other things. When the control of the higher brain centers is removed as in fever, in the earlier stages of ether anæsthesia or under "laughing gas," many of the overt forms of behavior shown in emotion take place spontaneously. The patient laughs or cries without apparent cause, he throws himself about, shouts, and sometimes tries to attack those about him as if in rage. Animals from whom the cerebral hemispheres have been experimentally removed frequently behave in much the same way. Tumors located in certain parts of the brain have been found to produce characteristic effects upon emotion both in its internal or "felt" aspects and in its external manifestations that other people can see. All this led certain physiologists to wonder whether or not the "older" or more primitive parts of the brain, parts in which the higher animals most nearly resemble man, might not be particularly active in emotion. As a test they removed not only the cerebral hemispheres but successive layers or regions of the brain stem in cats to see when the emotional behavior—"sham rage" as it was called because it took place without apparent cause—would cease to appear. They found that such operations had no effect on the behavior until they reached a part of the brain stem known as the *optic thalamus* or *diencephalon,* an ancient portion of the brain in which the difference between man and animal is far smaller than in the case of the cerebrum. After this region, shown in Figure 33, is removed, sham

* *Expression of the Emotions in Man and Animals.*

rage is promptly abolished and emotional behavior can no longer be evoked even by strong stimulation.

Does the cerebral cortex, the part of the brain which we have been taught to associate with the processes of thought and reasoning, the planned and deliberative aspects of mental life, then have nothing to do with emotion? Far from it. For

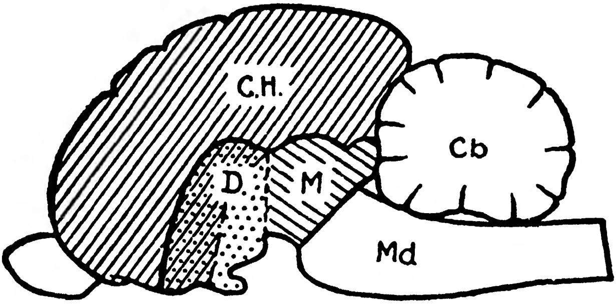


FIGURE 33

MEDIAN SECTION OF THE BRAIN, SHOWING THE LOCATION IN THE THALAMUS OF THE REGION BELIEVED TO BE MOST ACTIVE IN STRONG EMOTION

CH, cerebral hemispheres; *D,* diencephalon or thalamus; *M,* mesencephalon; *Md,* medulla. The cross-hatching from right downward to left marks the portion of the brain which can be removed without interfering with the emotional expression of rage. The posterior half of the diencephalon (indicated by dots without cross-hatching) is therefore assumed to be the part of the brain most concerned in the violent emotions, since with its removal rage responses are abolished.
(From *Bodily Changes in Pain, Hunger, Fear and Rage* by W. B. Cannon. Courtesy of D. Appleton and Company.)

emotion, as it occurs in the life of the normal person, is not the untrammeled aimless raving of delirium, not the sham rage of the decorticated cat that occurs without reason and strikes without object. The part played by the cortex in the emotional life of the normal human being in full possession of all his senses is that of control and direction of the forces set free by thalamic action. And emotion, to be experienced and realized to the full, demands some measure of cortical guidance, without which it wastes itself in a

fruitless display of physical energy that lacks both depth of feeling and strength of purpose. The thing that gives emotion its peculiar character is its feeling of drive, its insistent demand that you *must do* something about this at once. So long as the "something" remains vague and uncrystallized, so long as the impulse is undirected, and the energy left to expend itself in a thousand useless activities that give no satisfaction, the emotional experience is incomplete. But when reason takes hold, when the cortical processes assume control of the thalamic discharge, the picture is changed. The primitive impulse to activity, the need to do something, remains, but instead of being dissipated in all directions without useful accomplishment, the forces are unified and directed toward a definite goal. You no longer flee blindly, anywhere, anyhow, just so it is away from the bear, but you see a spot that promises safety and make for that. As soon as this occurs, as soon as the activity takes on form and purpose, the feeling changes. It is no longer, "I must do something, I don't know what," but instead, "I must and will do this."

It is just here, in the directing of the primitive forces released by thalamic action into useful channels, that the emotional behavior of the normal civilized human being differs from that of the decorticated cat, or the man suffering from delirium tremens. Emotion does not lose in strength by being brought under control but gains infinitely in form and vividness. Strictly speaking, the ravings of the person in the first stages of anæsthesia, or the "sham rage" of the decorticated animal, should hardly be regarded as true emotion. It is nothing more than the disorganized activity resulting when the cortex is thrown out of action, leaving the thalamus to be stimulated directly by the diffuse mass of uninterpreted sensations coming in from the sense-organs. The responses aroused are primitive and unadaptive, the person has no later memory of them, and they have no

effect upon his later behavior. "Conditioning" does not occur. In real emotion there is this difference, that the thalamic activity is aroused, not vaguely and indefinitely by sensations without cortical interpretation, but by sensations that cortical action has interpreted, that have taken on a meaning more or less clear. The cortex as well as the thalamus is then taking an active part in the arousal of the reaction that we call emotion, but it has temporarily delegated to the thalamus a part of its task of stimulating the body to action. As long as the cortex remains in command of the situation—as long, we say, as the individual keeps his wits about him—the coöperation of the thalamus lends to the whole experience a force, vividness, color, and warmth that it would not otherwise have. But when cortical control is relaxed, when the primitive nerve centers are left to work their will with the organism, then we have the blind, unreasoning terrors, the rages, the "brain-storms" that exhaust without profit and that have none of the return glow, the feeling of satisfaction, the "thrill" that comes when a strong emotion drives to accomplishment along a course made clear by reason and judgment.

This return glow, this feeling of satisfaction, is an integral part of normal human emotion. Without it no experience is complete, for every experience has its emotional component that needs to be satisfied. It is when this need is left unsatisfied, when the thalamic excitement exhausts itself without useful result or when cortical control is directed only toward repressing the outward signs of emotion with no attempt to divert the energy into suitable channels, that harm results. Emotion is the great driving force of life. Properly controlled and directed into useful courses it adds richness and depth to all experience, gives strength to our efforts, joy to our accomplishments. Allowed to run wild or dammed up without suitable outlet, it may wreak untold harm.

Only the coward seeks to avoid emotional experience.

Only the weak allow emotion to become their master. Emotion is not to be feared but sought, met squarely, ruled, utilized, and enjoyed. This is living.

The Growth of Emotional Behavior in Infancy

In the conditioning of emotional reactions we have a mechanism that in all probability furnishes the chief explanation for the modification of behavior in infancy and early childhood. It is a mistake to think that the results of emotional conditioning are seen only in the manifestation of emotional reactions under new conditions, in the attachment of the emotional response to a new stimulus. That is only the beginning. Emotional reactions, whether they be natural or acquired, are the forces that determine the child's relations to the universe about him, that decide what aspects of it he shall seek to explore and what he will avoid; what things he will actively try to change either by direct attack or by diplomacy, and what he will try to preserve and to bring into closer relation to himself. From the comparatively purposeless and undiscriminating reactions of infancy come the emotional experiences that give to the world its meaning and to the individual his purpose. And these meanings and purposes are highly personal affairs. It is not what an object or a situation *is* that matters, but what it can do to me and what I can do with it.

In this growth of meaning through maturation and experience lies the basis for the finer differentiation of emotional patterns that takes place with advancing age. The simple two-category reactions of the new-born infant, with pain or discomfort on the one hand shown by crying and increased speed and intensity of all bodily movements and pleasure or satisfaction on the other hand with its accompanying bodily states of relaxation, quiet, and perhaps low cooing or gurgling, like other forms of behavior soon begin to take on more definite outlines. And just as growth in motor be-

havior is characterized by increasing adaptation to the particular situation in which it occurs, so the diffuse, massive emotional reactions of the young infant gradually assume forms that are more appropriate to the exciting conditions. The baby cannot talk to tell us how he feels about things, but we can see very definite changes in his behavior from which we infer that his feelings, too, have gained exactness and clearness of outline. When his attempts to do something are thwarted, he struggles more violently to accomplish his ends and at the same time shows his displeasure by loud screams, kicking, and holding his breath. At first there is no direct attack on the person or object who is interfering with his activities, but about the end of the first year striking, slapping, biting, or kicking at the offender begin to occur.

This kind of emotional resistance, which is often (though not always) accompanied by emotional attack, we call anger. As the infant grows older, his desires and purposes become more clear-cut and varied because of the increased meaning that his surroundings have taken on for him and his consequent greater understanding of their possibilities for his personal exploitation and enjoyment. At first the infant has but few desires, and we cannot suppose that he realizes very clearly what these desires are. "Bodily wants" is probably a better name for them. But before very long he shows us pretty clearly that he is beginning to know quite definitely what he wants, and when he fails to get it anger ensues. There is probably no well-defined point at which the diffuse emotional reaction and generalized bodily struggle against interference with the gratification of some felt but not understood bodily need—which is the forerunner of anger in the young infant—passes over into the sudden and violent struggle, the direct attack upon the offender, the discharge of energy through such motor channels as stamping, jumping up and down, and dashing objects to the floor

that we see in children somewhat older and even, at times, among adults who are lacking in self-control. The change takes place gradually.

Much the same thing is true in regard to the behavior patterns that we describe as fear. At first, as we have seen, the baby makes a generalized reaction to circumstances that suddenly disturb him, but there are not many ways in which he can be disturbed. Watson and others have noted that loud sounds may do so on occasion, but it has also been found that it is not so much the loudness as the unexpectedness or unusualness of the sound that makes the disturbance. Sudden removal of support may have the same effect, or a quick jerk of the blanket, or a very cold hand suddenly laid on the baby's warm skin. At first the response to these or other disturbing conditions is so generalized and diffuse that only a knowledge of what has taken place enables us to put the behavior in the "fear" class rather than in the "anger" class or the "pain" class. Probably we should not call it fear at all, but the precursor of fear.

As age advances, other emotional patterns emerge. We see the beginnings of jealousy, coquettishness, affection, joy, surprise, shyness, and resentment all before the end of the first year. Not only does the list of emotional patterns lengthen with age, but the number of different situations that are capable of arousing a given emotion increases rapidly.

This increase takes place in several ways. First and most important is the increased number of possible occasions for the arousal of emotional states that inevitably comes about as the environment takes on meaning for the child. With the growth of meaning come more definite and stronger desires, and the more frequent the desire, the stronger the impulse, the greater will be the likelihood of interference or thwarting and the more frequent will be the occasions for anger. Likewise, only a relatively strong stimulus can

emerge from the unorganized environment of the young infant with the sudden and disturbing effect that we call fear, but as the child begins to know what to expect from the people and things about him, events, persons, and objects begin to stand out from each other and to take on new qualities. This is familiar, that is strange; for this happening he is prepared, for that one he is unprepared. Now whenever the child is placed in a situation that seems to require a response which he is unprepared to make, when he feels the need for responding in some way but does not know what response will best serve his purpose, he is most likely to try to solve the problem by avoiding the situation or escaping from it. To be sure, the unfamiliar situation is not always or necessarily the one which the child is unprepared to meet. Most children have a natural tendency to investigate an unknown object, to manipulate it in various ways; and if nothing has happened to interfere with this tendency, it is in itself an adequate preparation for responding to the new and strange. But if, on previous occasions, his attempts at investigation have been unsuccessful and unpleasant, so that some *new* method of meeting the situation is clearly called for and no such method occurs to him, the avoiding or escaping response that we call fear is very likely to appear. And if it so happens that over and over again his experiences in new and untried situations are those of failure, embarrassment, discomfort, or pain, the confident approach which is the child's natural response to any new situation that does not appear too overwhelming or that does not induce too general a bodily disturbance is likely to be replaced by withdrawal, retreat, flight; his interest and self-confidence by uncertainty, by feelings of inadequacy, insecurity, and inferiority.

The secret of maintaining a child's self-confidence and of preventing undue timidity or fearfulness lies in seeing to it that his natural exploratory tendencies meet with pleasant-

ness and success whenever this is possible; and that, when these tendencies lead him into ways which he must be taught to avoid because real danger lies in that direction, in making sure that he is taught *the right way to respond* and is not simply left to find out that his own way leads to unpleasant consequences. Fear comes when we have no satisfactory way of meeting a situation; it disappears when we know exactly what to do and are able to do it. This explains why flight from a situation is not always accompanied by fear. If we recognize that the situation is one to be avoided, and if we know exactly which way to run and are certain that our legs can be depended upon, flight from danger may become an exciting sport, as every country boy who has teased an irate gander knows.

So with anger. If we wish to train children to be even-tempered on most occasions and to reserve their anger for circumstances under which anger seems to be justified, we shall be most successful if we direct our attention to the impulses and attitudes from which behavior springs. Anger comes when a strong impulse or desire is thwarted. In a world made up of many people, the child who does not early learn the necessity for reasonable conformance to the rights and wishes of others but who must have his own way at all cost is likely to meet with many difficulties that the more coöperative child will escape. The inflexibility of purpose on which some people pride themselves is not always a virtue. It is much more likely to be plain bull-headedness. Leadership has no greater asset than the ability to see the other person's point of view.

Chapter X

THE SOCIAL REACTIONS OF INFANTS

What is the relationship between the growth of emotional attitudes and social development in the infant?

What changes take place in social behavior during infancy?

How do Bühler's three "types" of social behavior as seen in the infant compare with your observation of older children and adults?

How did the psychologist of a generation ago regard play, and what is the difference between this point of view and that of the psychologist of to-day?

What do we mean by "insight," and how does learning by insight differ from the learning of the lower animals?

Is it equally easy for all children to gain insight into social situations? Why not?

The First Responses to Human Beings

The child's social life begins as soon as he is born. Within a few weeks after birth his reactions to other persons can be clearly distinguished from his reactions to inanimate objects. When people come near him he turns his head in their direction, follows their movements with his eyes, is quieted by the sound of the human voice. By the end of the second month smiles appear when an adult bends over him and chirrups or speaks caressingly to him. So strong is this interest in people that by the third month it becomes prac-

tically impossible to carry out any kind of psychological investigation that requires the securing of the baby's attention unless the observer remains hidden from his sight, for few objects are so engrossing to the child as a moving, speaking human being.

The baby's first reactions to human beings are positive. He watches them, smiles when they speak to him. It makes no difference, in the beginning, whether the voice is kindly or threatening, whether the face smiles or frowns. All his associations with human beings are pleasant; he expects, we may say, nothing but kindness from them. But at about the age of five months his response to frowns and a threatening voice or gesture begins to be somewhat different from that shown to a smiling face and a friendly voice.* To the latter he continues to respond by smiling and approaching movements; but the threat or the frown is likely to cause withdrawal and in many cases crying. A little later, many children begin to reinterpret the threat as a form of play, and after a moment's hesitation respond once more by smiling and laughing.

Awareness of strangers appears at about the same time that the differentiated response to friendly and unfriendly voices can be observed. The baby is less responsive when a stranger appears; he sits quietly and stares without smiling. If the stranger approaches too near him or tries to take him in his arms, the baby draws back and perhaps begins to cry. In all this there are great differences between children, differences that it is often hard to account for purely on the basis of experience. It is very probable that hereditary tendencies are involved as well; tendencies that do not fix the behavior irrevocably, but that predispose some children to be unduly disturbed by unfamiliar and perhaps unskilled methods of handling and hence, all other things being equal,

* C. H. Bühler and H. Hetzer, "Das erste Verständnis von Ausdruck im ersten Lebensjahr," *Zsch. f. Psychol.*, 1928, 107: 50-61.

to be more easily "conditioned" against unfamiliar social contacts thereafter.

The very young infant is less likely to respond to other children than to adults, but this is probably because adults are larger and more active, because they are likely to make stronger attempts to attract his attention, and—perhaps most of all—because adults rather than children have ministered to his daily wants and have therefore become objects that have special and personal meaning for him. Bühler,* in a study of the social reactions of infants toward each other, reports that when two babies less than six months old are placed in the same crib facing each other they are likely to pay little attention to each other. If an infant happens to meet another's look, he may smile as he would at an adult, but at this age babies do not make active advances toward each other. In the second half-year, however, the baby begins to make definite attempts to attract the other child's attention. He touches him, makes cooing sounds, and interferes with his activities. If the other baby does not respond he may go further. He squeals, pulls the other child's feet or clothing, snatches at his toys. Before the end of the first year, practically all the forms of social behavior seen in later life can be observed in embryonic form. There is domination of one child by another, leadership, rivalry, bullying, and submission. There is imitation, coöperation, generosity, and selfishness. There is the dog-in-the-manger child, who snatches all the other baby's toys but makes little attempt to play with them. There is the overgenerous child who proffers all that he has to the other.

Elsewhere Bühler describes three general types of social behavior that can be observed in children between the ages of six and eighteen months, as follows:

* C. Bühler, "Die ersten sozialen Verhaltungsweisen des Kindes," in *Sociologische und psychologische Studien über das erste Lebensjahr* (Jena: Gustav Fischer, 1925).

"(a) The *socially blind* infant behaves in the presence of another child as if nobody were present; he looks at the other without any emotion, he takes toys, plays and moves without any regard for the other child; he does not pay any attention to the other's movements; he is neither impressed nor interested in the other's presence or activities. (b) The *socially dependent,* on the contrary, is deeply impressed by the other's presence and activities; he can either be inhibited or else be stimulated by the other's presence. In the first case he will not move, will watch the other or copy him, will obey him, and sometimes even give signs of fear in front of him; in the second case, he will display in front of the other, will demonstrate objects and gestures, will try to rouse the other, and sometimes will even get enthusiastic and excited. In both cases all his movements are dependent on the presence of the other child; he observes the effect of his behavior on the other and carefully watches the other's reactions. (c) The third type is still different. The *socially independent* child is one who—though aware of the other's presence and responsive to his behavior—yet does not seem dependent on him, is neither intimidated nor inspired. He reacts to the other, wards him off when necessary, yet never becomes aggressive himself. He may or may not join the other in play, is not inconsiderate, but sometimes even consoles the other, encourages him, takes part in his activities; yet, with all that, he remains independent in his movements; for instance, he may suddenly turn away and do something for himself." *

All these types may be seen among older children and adults as well as in babies. Just how persistent they may be we do not know. Whether or not the baby who pays little attention to the people around him is more likely than others to develop into the "socially blind" adult who keeps to himself, lives for himself, and when thrown into the society of others makes all kinds of social blunders because of his insensitivity to the way his associates are reacting; whether

* Charlotte Bühler, "The Social Behavior of the Child," in *Handbook of Child Psychology,* Carl Murchison, ed. (Worcester: Clark University Press, 1931).

or not the gregarious baby becomes the highly socialized man or woman, and the child who is socially.independent in infancy continues to be able to get along with his companions or without them as circumstances seem to require are questions that the future must answer. Bühler tells us that the babies whom she studied behaved, on the whole, in much the same way on repeated trials at intervals of a few weeks or months, but that is not long enough to tell the whole story. Common sense as well as everyday observation, however, would lead us to think that in social matters as well as in other things such as health and physical development, the child who gets a good start early in life has an advantage over the one who does not.

Social training, then, does not begin when a child enters dancing-school or when he goes to kindergarten, or even when he begins to speak and is taught to say "thank you" and "if you please." Social habits have their starting point much further back. Their basic patterns are laid down in early infancy, before formal training begins, in the unremembered period before speech when impulses and attitudes are translated directly into action. The social behavior of the infant differs from that of the adult in many of its details, but its broad outlines foreshadow the form that it may later assume.

The Interests and Play Activities of Babyhood

A generation ago the question of the nature and function of play was much discussed. The question that occupied the minds of older philosophers and psychologists was, Why does the young child or animal play? In an attempt to answer the question, three major theories were evolved which are worth considering because each undoubtedly contains some truth and all have contributed something to present views of child development.

To Spencer, play is chiefly an *outlet for superfluous*

energy. The infant kicks, rolls, squeals; the child prances about, the lambs gambol on the hillside, and college boys tussle with each other "for fun" just because of a superabundant supply of health and vim that has to be worked off somehow.

G. Stanley Hall derived much of the evidence for his recapitulation theory from the observation of children's play. Briefly stated, the theory is this: *The child, in his development, repeats the history of the race.* So in his play, the child goes through the same stages as man followed in his progress toward civilization. The theory was worked out in the greatest detail, and at about the turn of the last century educators were busy attempting to adjust the school curriculums to fit the particular levels of culture through which the children of each age were supposed to be passing. There was the "stone age period," the "big Injun period," and so on, each of which was thought to require its own special modes of instruction. The six-year-old representatives of the "stone age" were encouraged to dig caves, scrawl crude pictures with big crayons, and make mud-pies; while the "big Injuns" of nine or ten learned to shoot with bow and arrow, make baskets and pottery. We smile at the theory, but the practice, after all, did not work out so badly. And the theory had this tremendously important consequence, that it turned the attention of scientists in many fields to the study of child development as a means of understanding adult behavior—to the source as a means of understanding and controlling the product.

Groos, in whose well-known book *The Play of Man* the most clearly elaborated theory of play is set forth, holds an opinion that in many respects is the converse of the recapitulation theory just described. Groos regards play as an unconscious *preparation for adult activities*, or as Stern puts it: "Play is the instinctive self-development of budding capabilities, the unconscious preliminary practice of future

functions." * The little girl who cares for her doll is unconsciously preparing herself for the care of a. baby later on: the boy who hammers nails into a board for fun is preparing himself for the serious constructive work of the man.

Most of us will find something in each of these theories with which to agree, but none of them is entirely satisfying. In the first place, each seems to assume that play is something set off from other life activities, that it is in a category by itself and so demands a theory by itself. This is untrue. Play is just a name that we give to activity when it seems to be particularly spontaneous, initiated and controlled by the impulses of the moment rather than by the vision of some more remote goal. Play is not set off from work by any hard-and-fast line, but the one merges into another. That which is play to-day may become work tomorrow. Activities that it is hard work to learn may be fun once they are learned. Children play more than grown people because they have not yet reached a level of maturity or had sufficient experience with the laws of cause and effect to enable them to look very far ahead—also, probably, because all their bodily processes are going on at a faster rate, so that their energies demand a more immediate outlet.

We shall agree with Spencer that the bodily need for converting energy into action provides an immediate impulse for activity, and that this explains in large measure why sick children play less than healthy ones. But it does not tell us why the healthy baby of eighteen months works off his energy by running back and forth, shouting and squealing, while the boy of twelve makes for the baseball field. We shall agree with Hall that people of undeveloped minds, whether they be children or savages, show certain points of similarity in their play, but we shall not ascribe this to the

* Wm. Stern, *The Psychology of Early Childhood,* translated from the sixth German edition by Anna Barwell (New York: Henry Holt and Company, 1930).

survival of any racial memories in the child. We can have no doubt that in the course of the child's play he learns much that will be of value to him later on; but although he learns by playing he does not, either consciously or unconsciously, play in order to learn.

The modern psychologist is interested in children's play for reasons very different from those that motivated his predecessors. He does not ask why children play but how they play. What are the characteristic differences in the play of older and younger children, of children reared under very different conditions? To what extent do the play interests of the child to-day foreshadow what he will become tomorrow? What influence have the social and emotional experiences gained in one's play as a child upon such qualities as leadership, independence of thought and action, and ability to get on happily with one's fellows later on? To what extent are the vocational choices, the hobbies, and the recreations of the adult the direct outgrowth of the play preferences of childhood? Much further investigation is needed before these questions can be answered completely, but, as we follow the course of development onward, we shall see how closely the play life of the individual reflects the development of his whole personality, portrays his interests, his abilities, his past experiences. Had we but the wisdom to read the signs, we should find in the child's play the surest index to his character.

The play of the infant and very young child is very largely concerned with the gaining of new sensory and motor experiences. The baby of four months fingers the table edge or the edge of a book when his hands come in contact with it. He likewise manipulates his own hands, toes, and ears with an expression of absorbed interest. He kicks, squirms, and squeals with glee when undressed, kicks out freely in his bath, perhaps splashes with his hands. A little later he begins to discover his own talents as a noise-maker and

spends much time in squealing and babbling and in producing queer bubbling and gurgling sounds for his own amusement. Still later he finds that objects, too, can be made to produce interesting sounds at his will, and now comes an era of rattle-shaking, of hammering spoon against cup or table, of rasping one toy against another. Then he becomes the young Newton and the concept of gravitation is born anew in his baby mind as he gleefully drops one object after another from the tray of his high-chair to the floor and then screams until some one picks them up for him to drop again. He learns to creep, then to walk, and walking itself is for some time as fascinating a sport as skating, swimming, or mountain-climbing is for you. With the ability to get about and explore the world for himself, new experiences are gained daily, objects acquire new qualities for him; he begins, however, vaguely and indefinitely, to grasp the idea that the universe is governed by laws that he can adapt to his purposes once he knows what they are. A little later we shall find him asking continually, "How do you do it?" "What makes it go?" but long before he begins to talk, even before he can walk without help, the baby of twelve to eighteen months shows clearly that he has formed many implicit generalizations about the way people and objects behave. In these generalizations lies the basis for the kind of behavior that is often called insight, the ability to behave appropriately in new situations, to solve a particular problem by the help of a general law.

The Beginnings of "Insight" in Infancy

The ability to use tools is one of the marks that distinguishes man and to a lesser extent the monkey from animals below the level of the primates. Köhler, in his fascinating book on the behavior of apes,* describes many

* W. Köhler, *The Mentality of Apes* (New York: Harcourt, Brace and Company, 1925).

instances of tool-using and even of a primitive kind of tool construction in chimpanzees. When a banana was hung just beyond the reach of a hungry chimpanzee, he would bring boxes, pile them one upon another, and climb upon them in

FIGURE 34

CHIMPANZEE FITTING TWO STICKS TOGETHER TO MAKE A LONGER ONE WHICH HE CAN USE TO OBTAIN FOOD

(After Köhler from *Great Experiments in Psychology* by H. E. Garrett. Courtesy of The Century Co.)

order to reach it, or he would get a stick and knock it down. Babies early learn to use pieces of furniture in the same way. Babies and apes alike find that sticks, spoons, or other objects can be used to pull objects toward them or to poke things out of crevices. (See Figure 34.) In using

objects in this way they show, by their mistakes as well as by their successes, that they are responding to ideas about objects and not to objects as such. The ape who uses a stick to knock down a suspended banana may try to do so with a bit of straw if no stick is handy; the baby gets many a bump from his attempts to use a rocking-chair or other unstable object as a highway to the cookie-jar.

These are simple matters, yet they signify an enormous advance in power of thought over that indicated by the direct bodily attack which is the only method of problem-solving that animals below the level of the primates are likely to display. The dog, the horse, and the rat will starve with food hanging within their sight, no matter how many objects are available that could be used as stepping stones and that are quite within their power to move. To be sure, the development of the hand as an instrument for grasping and holding makes it simpler for the child or the monkey to use tools than it is for the horse or the dog to do so, but this cannot entirely account for the difference.

But the use of tools is not the only way in which the child shows his ability to generalize. He forms ideas about people as well as about objects, and he uses people as tools in much the same way as he uses objects. The baby who cannot talk will tug at his mother's skirts and drag her to another room where by pointing and vociferous jabbering he makes her understand what it is that he wants her to get for him. By the end of the first year babies show by their behavior that they have begun to sort people into rough classes. They respond to children in one way, to adults in another way; they may even show some difference in their responses to men and women. Here we have the beginnings of social insight. As children grow older, insight into social situations becomes increasingly important for their happiness and success in life. Although the social behavior of babyhood is almost wholly egocentric in the sense that, for

the most part, the baby uses other people as devices for the promotion of his own pleasures and desires, he soon learns that his human devices, like other tools, work better if he handles them in certain ways.

Individual Differences Among Infants

Thus far we have talked about the child as *the* child and have emphasized the points of similarity among children rather than the differences between them. But children differ even at birth; and as age advances these differences become more easily seen. With their differences in size, features, and coloring we are all familiar. We know, too, that some babies are strong and healthy from the start and that others are sickly. But it does not require much observation to show that there are other differences which likewise exist from the beginning. This baby starts and cries at the least provocation or even without apparent cause. That one remains placid. This one is active, energetic, and responsive, that one sluggish. And as babies grow, they respond differently to experience and training. If several children of different emotional and personality make-ups are placed in an environment where annoyances are unusually frequent, one of them may build up a protective shell from which the difficulties roll off "like water from a duck's back"; another may fight back and, being continually on the look-out for trouble, go around, as we say, with a chip on his shoulder; a third who is too timid to fight and who lacks the shell-forming ability may withdraw more and more from the group and try to find safety in solitude, companionship in day-dreams, satisfaction in imaginary accomplishment. The beginnings of these behavior patterns are laid down in babyhood, but too often they remain unrecognized until the habits have been so well formed that it is hard to change them. Or if a child, no matter what his original disposition may be, is reared in a situation where he is overprotected,

overindulged, where the give-and-take of normal childhood intercourse is denied him, his behavior will tend to conform to the kind of education that is given it. As long as the pattern of education remains the same, as long as new kinds of demands do not occur, all seems to go on well, but changes must come as the child grows older. They will be met more easily if they are not too great, if even in babyhood the child has begun to learn the habits of social conformity and social coöperation that he will be called upon to practise later on.

Babies differ. They differ in abilities of all kinds—in intelligence, in social adaptability, in tenacity of purpose, in emotional control.

Their experiences differ. One is indulged, another is unduly repressed; one is permitted and encouraged to find out all that he safely can concerning the things about him. He investigates the qualities of sand, the anatomy of grass and flowers, the behavior of bugs and beetles. He learns to go up and down stairs without being carried and rightly considers that the knowledge has been cheaply gained at the price of a tumble or two. Another is surrounded by a barrier of "don't's" and "mustn't's." One child finds the adults about him behaving in a consistent fashion that gives him the beginning of insight into social relationships and lays the foundation for a feeling of confidence in the reactions of others. He knows what is likely to happen and is able to adjust to it. His social world as well as the world of nature seems to behave in a reasonable fashion that he can learn to understand, that he is not afraid to grapple with and try to control. Another is unexpectedly kissed, slapped, laughed at, played with, indulged, repressed, praised, and scolded according to no apparent principle or rule.

Out of all these differing abilities and experiences, behavior is shaped.

Chapter XI

THE DEVELOPMENT OF COLOR-VISION IN INFANCY

At about what age do children become able to see color? Is it likely that all colors are perceived with equal readiness at first?

What physical properties of light form the basis for color sensations?

What theories have been proposed for explaining the facts of color-vision, and how well does each agree with what is known about color-vision in normal and color-blind adults? How do these theories check with findings from recent studies on color-vision in infancy?

At What Age Does the Baby Become Able to See Colors?

At birth, as we have seen, it is very doubtful whether or not the infant is able to perceive color as such. He responds, it is true, to colored light, but his responses vary in intensity with the brightness of the light and not in accordance with the particular color used. At what age does color-vision develop?

The best information we have to date is provided by Staples.* Staples studied the responses to each of four colors, red, blue, yellow, and green, using as subjects twenty-five infants whose average age was eighty-seven

* Ruth Staples, "The Responses of Infants to Color," *J. Exper. Psychol.*, 1932, 15: 119-142.

days. Her method was to present before the infant two disks, each three inches in diameter, against a neutral gray background. One of the disks was colored, one a gray of the same shade as the background. The disks were made from the Munsell "Atlas" papers, a special series of colored papers arranged according to a numbered scale that makes it possible to match papers of different colors on the basis of their brightness, that is, according to a scale with white at one end and black at the other. The brightness of colors can be measured with an instrument called the spectrophotometer; and, according to a study made by the United States Bureau of Standards with such an instrument, the "brightness values" assigned to these papers are extremely accurate. In this experiment the colors and the gray used were all of equal brightness. Unless the babies were able to see color, all the disks should have looked alike to them.

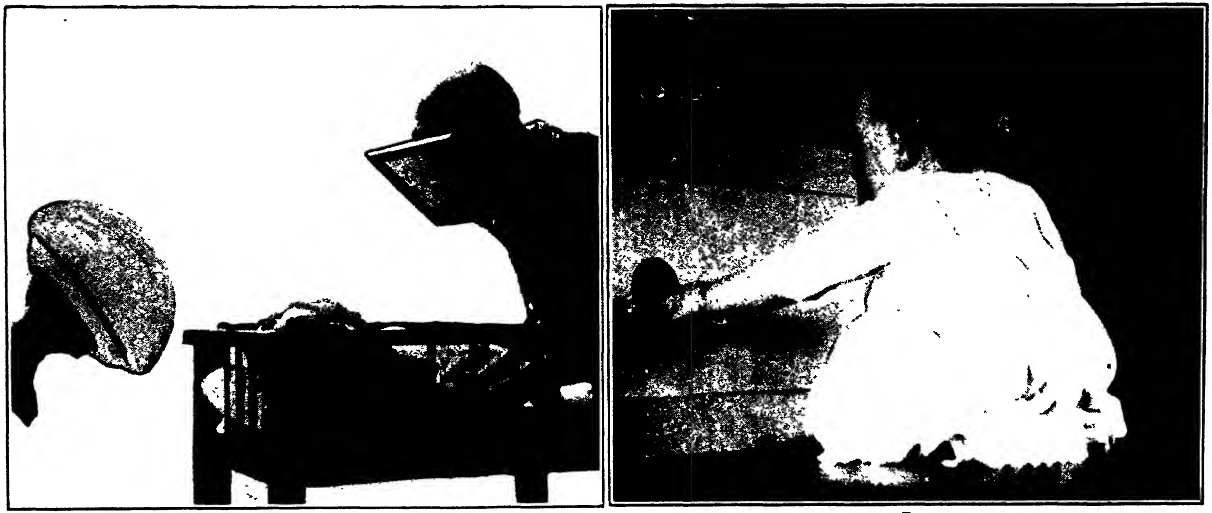
The baby to be tested was propped up with pillows in his crib in a darkened room. Directly behind him was a daylight lamp with a globe to diffuse the light so that the screen which served at once as a background for the disks and as a means of concealing the observer from the infant would be equally illuminated at all points. This screen was exactly twelve inches from the baby's eyes. The disks were attached to the screen, six inches apart from each other. The observer watched the baby's eyes through a narrow slit in the screen and noted on a stop-watch the exact length of time the baby looked at each disk. At the end of two minutes the times were recorded, the baby was played with for a minute or two, then the positions of the colored disk and the gray disk were reversed on the screen and the experiment repeated as a check. All four colors were handled in the same way. (See Figure 35A.)

Because the attention of babies as young as this is so hard to hold, there was great variation from one baby to another both in the total length of time the disks were looked at

(as compared to the time when the gaze wandered idly about the room) and in the amount of attention given to the colors as compared to gray. But when the results for all the babies were totaled, it was found that every one of the colors had held the attention for a longer time than the gray with which it was paired. On the average the ratios were about two to one. The rank of the colors, according to seconds looked at, was yellow, blue, red, green, but the differences between colors were not very great and the ranks varied from child to child so that it is unsafe to draw any conclusions regarding color preferences from these data. It seems reasonably certain, however, from a statistical evaluation of the results, that the infants saw color as something distinct from gray, and that when both were equally bright, color was for them a more interesting sensation than gray. By the age of three months at least a rudimentary sense of color seems to have developed.

The second part of the experiment was carried out with 118 infants between the ages of five and a half months and twenty-four months, six of whom were tested twice, making a total of 124 tests. Papers of the same colors as those used with the infants were employed, but in this case the child's preference was judged by holding before him the card on which the two disks to be compared were mounted, urging him if necessary to "get the ball," and then noting to which of the paired disks (color or gray of the same brightness as the color) he pointed. Care was of course taken to present the card exactly in the midline of the child's body so that no advantage of position would be given to either disk. (See Figure 35B.)

Table 1 shows the results of this experiment. It will be noted from this table, first, that as age advances the number of times the color is reached for steadily increases. This is true for all colors. Secondly, the order of color preference as indicated by reaching remains the same for all ages



A

B

FIGURE 35

STUDYING THE REACTIONS OF INFANTS TO COLOR

A. Observing the ocular fixations of young infants B. The older child reaches for the color that most strongly attracts his attention.
(Photographs by courtesy of the University of Minnesota Institute of Child Welfare.)

Table I

Responses to Colors When Compared with Gray

(Infants of 5½–24 Months; $N = 124$)

(After Staples)

Colors Compared	Type of Response	Percentages for Age Group I (6-8 mos.; $N = 28$)	Percentages for Age Group II (9-11 mos.; $N = 27$)	Percentages for Age Group III (12-14 mos.; $N = 22$)	Percentages for Age Group IV (15-18 mos.; $N = 22$)	Percentages for Age Group V (19-24 mos.; $N = 25$)	Percentages for Total Group ($N = 124$)
Red	Reaching for color...	68.8	80.3	86.8	94.8	93.0	83.7
Gray	Other responses......	31.2	19.7	13.2	5.2	7.0	16.3
Yellow	Reaching for color...	59.3	81.8	84.0	92.6	100.0	81.7
Gray	Other responses......	40.7	18.2	16.0	7.4	—	18.3
Green	Reaching for color...	45.9	60.7	76.8	88.1	90.1	70.9
Gray	Other responses......	54.1	39.3	23.2	11.9	8.9	29.1
Blue	Reaching for color...	49.5	70.1	75.4	94.7	92.2	74.9
Gray	Other responses......	50.5	29.9	24.6	5.3	7.8	25.1

within this range. Red comes first, then yellow, then blue, and finally green. Up to the age of fifteen months, moreover, the four colors separate fairly sharply into two groups with red and yellow at the top and blue and green much lower.

As a check a third experiment was carried out in which the colors, still matched for brightness, were paired with each other rather than with gray. Every color was shown in connection with every other color. A group of 121 infants of the same age-range as those used in the second experiment served as subjects. Upon the assumption that *differences equally often noticed are equal,* a principle much used in psychological work, the results of the babies' choices were calibrated in such a way as to show, not only which color was preferred at each age but also how much it was preferred to the one ranking next to it. This is shown graphically in Figure 36.

The order of the colors is the same as that found in the second experiment, red, yellow, blue, and green; but the preference for red is very outstanding, while the differences between the remaining colors are comparatively small. Very significant is the fact that as age advances the difference between the colors best liked and those least liked by the group as a whole becomes steadily smaller. This means that the younger children agreed with each other very well in choice of colors, but the older ones showed more individuality in their choices, some preferring one color, others another. With the youngest children red leads by a clear majority of all votes, but at the upper ages, although red continues to have a small advantage over the other colors, the results are much more nearly tied.

As a final test, the same color-pairs were presented to fifty preschool children between the ages of two and a half and five years; 100 grade-school children from seven to twelve years of age, and 100 college students. The pro-

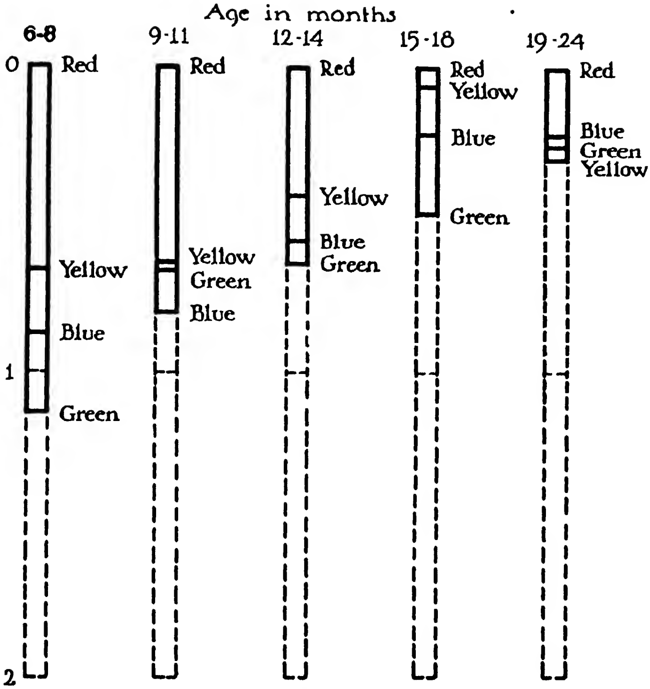


FIGURE 36

THE COLOR PREFERENCES OF INFANTS AT DIFFERENT AGES

The distance between the positions of the colors on the vertical bars shows the extent to which the babies agreed in choosing certain colors in preference to others. Wide spacing indicates fairly general agreement; close spacing means that some babies chose one color, others another, so that when all the choices were pooled one color had but little advantage over another. The fact that the choices of the younger infants show much greater agreement with each other than do those of the older ones strongly suggests that at the earlier ages the colors were not all perceived with equal readiness.

(From Ruth Staples, "The Responses of Infants to Color," *J. Exper. Psychol.,* 1932, 15: 119-141. Courtesy Psychological Review Co.)

cedure used was exactly the same as with the infants. The comparative scale values are shown in Figure 37.

In interpreting this figure, attention should be called to the fact that it is impossible to keep the brightness of different colors the same and still have all the colors highly saturated—that is, strong, clear colors. A clear bright yellow, as we all know, is much lighter in color—much nearer the white end of a scale running from black to white—than is a clear, strong red or blue. So, in selecting the colors for this experiment, the colors used were the most saturated hues possible within a uniform brightness series which gave a strong red and good tones of blue and green; but, in order to have the yellow as dark as the other colors, it was necessary to use a rather brownish shade that the school-children and adults often called "tan." This did not seem to bother the babies, but it probably accounts for the rapid falling-off in preference for yellow among the older children and the adults.

What may we conclude from all this? Let us put the facts together and see what we have.

1. At birth babies respond to light, whether colored or uncolored, but the frequency and intensity of their responses seem to be determined by the brightness of the light and not by its color. There is no real evidence that the new-born baby sees color as such.

2. By the age of three months color begins to take on special stimulating value for the infant, as is shown by the fact that he will look at a colored disk for about double the length of time that he will look at a gray disk of the same brightness; but there is no reliable evidence so far that one color stimulates him more strongly than another.

3. By the age of six to nine months, color preferences are present in marked degree. Red is liked best, yellow next, blue next, and green least. At this age there is fairly close agreement among all babies as to color choice.

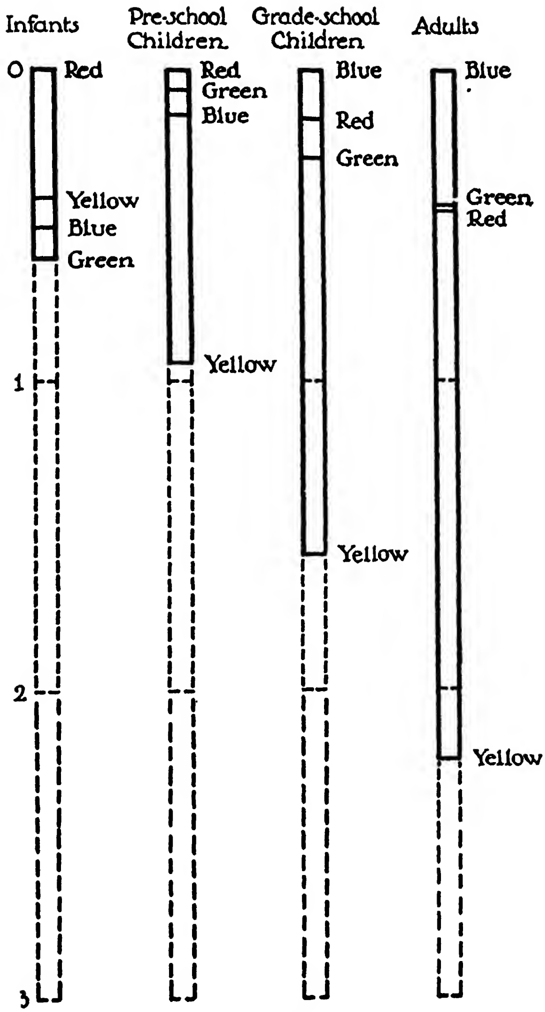


FIGURE 37

CHANGES IN COLOR PREFERENCES FROM INFANCY TO MATURITY

The marked decrease in liking for yellow among the older subjects is probably to be attributed to the fact that the yellow used in this experiment was not a saturated color.
(From Ruth Staples, "The Responses of Infants to Color," *J. Exper. Psychol.*, 1932, 15: 119-141.)

4. Between the ages of nine months and twenty-four months the tendency for all or most children to prefer certain colors rather than others steadily decreases. Although the colors maintain their original order, the differences between them are far less marked and less consistent from child to child.

5. After the age of two, the yellow used in this experiment (which was not a clear yellow, since a saturated yellow would be much brighter than the other colors) steadily lost in preference value, while blue and green moved up the scale. Among adults, the preference order for the colors used was blue, green, red, yellow. The two colors most liked by the babies were least liked by the adults.

Theories of Color-Vision

In Chapter V we likened the eye to a camera, and so far as the perception of light and form is concerned the comparison is fairly exact. But when we come to the perception of color the resemblance breaks down, for the ordinary camera does not reproduce color. The usual method of color photography depends upon the use of special filters to which nothing in the eye exactly corresponds.

The question of how the eye responds to color is still unsettled. Earlier psychologists attempted to find an answer by investigating certain peculiarities of color-vision in adults, for until recently few reliable data on the responses of infants to color were available and the little work that had been done was not well controlled. The facts with which they had to work were these:

(1) *The physical characteristics of light.* As most of you will recall from your elementary physics, light may be described as vibrations or waves traveling through space at the rate of about 186,000 miles per second. The vibrations vary in rate, and the faster the vibration, the shorter the length of the individual waves. If in one case twenty vibra-

tions occur within a given unit of time or distance and in another case the same space is occupied by only ten vibrations, it is obvious that the length of the individual waves in the second instance must be double that of those in the first. It is known that the stimulation of the retina by light-waves of different lengths is the primary factor in giving us sensations of such different color-tones as red, green, blue, yellow. The longest visible wave-lengths (about 760 millionths of a millimeter) give us the sensation of red; the shortest (about 390 millionths) give us violet. In the rainbow or spectrum the waves are arranged in order according to length, and so it is that the rainbow looks red at one edge and violet at the other, with the other colors occurring always in the same order in between. Outside the limits of visible light there are other waves both longer and shorter, but these waves do not stimulate our organs of sight, though they may affect us in other ways.

(2) *The attributes of color as sensed by us.* First of all, we have colors that seem to us so essentially different from each other that we give them different names; they seem to differ in regard to the very thing that makes them colors as distinct from mere light and shade. These are the primary color-tones, or hues,—red, yellow, and so on, which depend on wave-length. Yet these colors are not sharply separated from each other if they are arranged as they are in the spectrum. Red shades off through orange into yellow, yellow passes into green, green into blue, and so on. And the strange thing is this. If we start at the long end of the spectrum, we find the colors merging into each other as the wave-lengths gradually decrease, and this seems natural enough; but when we get to the short end, we find that the violet rays pass over through purple into red and so we are back at the beginning again, thus compassing the gap from the shortest to the longest wave-length with what seems like a very small difference in the sensation.

In other words, although the spectrum itself is a band of color with violet (corresponding to the shortest waves) at one side and red (corresponding to the longest waves) at the other, in our color sensations the extremes seem to meet and blend as if the band were bent around into a circle. Violet, the sensation resulting from the shortest waves, merges with red which results from the longest waves just about as readily as red passes over into yellow.

Sensations of color also vary in brightness and in saturation, as was indicated in the discussion of the infant experiment just described. The brightness series, you will remember, runs from black through a series of lighter and lighter grays to white. When we speak of "light colors" or "dark colors," "pale blue" or "dark blue," we have reference to brightness. Colors also vary in respect to saturation, that is, according to their strength, to the amount of the color they seem to contain. Roughly speaking, brightness depends on the energy of the light striking the retina and saturation upon whether the waves are all of the same length or of varying lengths, but both brightness and saturation are complex qualities affected by a number of different factors that cannot be gone into here.

(3) *Color mixing.* By mixing lights of different colors (not paints, which is a different matter, because paints absorb part of the light and so change its value) it is possible to produce color sensations that seem to us just like pure colors, that is, colors as seen when the wave-lengths are all equal. The mixing can be done either by throwing the lights to be mixed directly into the eye, by throwing them simultaneously on a white screen, or by using a color wheel on which the colors alternate so rapidly that the retina cannot act fast enough to see them as separate colors. (See Figure 2.) Hence they blend like the spokes of a rapidly revolving wheel and appear as a single color. A striking thing about color mixture is this: In many cases the colors blend and give

an intermediate color, as one would expect. Red mixed with yellow gives orange; red mixed with blue gives purple or violet; green mixed with blue or with yellow gives a greenish blue or a greenish yellow as the case may be. But if we mix yellow and blue, we do not get an intermediate color, but white or gray; if we mix red and green, the same thing happens except that, unless the green is slightly bluish, the resulting sensation is that of a dull yellow rather than white. These sensations do not blend.

By appropriate color mixing, then, it is possible to get all the color sensations in the entire spectrum from only three colors, red, green, and blue. Well over 100 years ago, this fact led Thomas Young to propound a three-color theory of color-vision which was later elaborated by Helmholtz and is now known as the *Young-Helmholtz theory of color-vision.* Briefly, it affirms that there are in the eye three kinds of receptors that are stimulated by light-waves of different length. Waves of any length will stimulate any of the three kinds of receptors, but not with equal readiness. There is one kind, so goes the theory, that is particularly sensitive to the long wave-lengths and from these we get the sensation of red. Another kind is particularly sensitive to the wave-lengths that give us green, another to the blues. The different colors, then, result from the relative strength with which the three different kinds of receptors are stimulated by the light-rays. According to this theory, white was supposed to result from simultaneous stimulation of all three, but the more recent work of Von Kries and others has shown rather conclusively that colorless vision—the black-gray-white series—is rod-vision (see p. 94ff), so this part of the theory is no longer accepted. There are other objections to it, as we shall see; but, as Selig Hecht * points out, although

* Selig Hecht, "Vision: II. The Nature of the Photoreceptor Process," in *Foundation of Experimental Psychology,* Carl Murchison, ed. (Worcester: Clark University Press, 1929), pp. 216-272.

the theory in its present form may be incomplete it may nevertheless serve as a basis on which to build a more adequate theory of color-vision than any that has been proposed to date.

(4) *Positive and negative after-images.* Many of the sense-organs continue to respond for a moment after the stimulus ceases. There is an old-fashioned parlor trick in which the blindfolded victim is told that a penny will be attached to his forehead so firmly that he cannot shake it off without touching it with his hands, but that no bandages or other adhesives will be used. A cold penny is pressed firmly against his forehead for a moment and then removed, care being taken that it does not slip and that the fingers do not touch the skin in the process of removal. If the trick is skilfully done, the persisting sensation will make the subject think the penny is still there, and he will go through a violent series of contortions, shaking his head and even rubbing it against pieces of furniture in an attempt to rid himself of the penny.

Visual after-sensations are especially interesting. If you look quickly toward the setting sun or any other strong light and then look away, you will continue to see the light for a moment, though your eyes are no longer on it. This is the positive after-image, but negative after-images also occur in which brightness values are reversed. The light is replaced by black and the black by light, as on the photographic film after the picture has been developed. If a colored object is used as the stimulus, colored after-sensations may be observed. The positive after-sensation has the same color as the object by which it was stimulated, but the negative after-sensation of red is bluish green; that of blue is yellow.

(5) *Color-blindness.* A few people exist who cannot see colors at all; the world appears to them like a photograph done in shades of gray. You can get something of the effect

of this yourself by trying the following simple experiment. Look fixedly at a point directly in front of you and have a friend slowly advance a small piece of colored paper into your field of vision from one side. As soon as you are able to see it "out of the corner of your eye," try to guess its color. You will not have good luck. In the outer zone of the retina there are rods but only a very few cones, and in that part of the visual field every one is practically color-blind. We do not know the mechanism by which the cones respond to color, but we do know that it is the cones and not the rods that do so.

In addition to total color-blindness there is partial color-blindness. This is much more common. We spoke of it before in Chapter III as an inherited defect of the sex-linked type. Being sex-linked, it is much more common among men than among women. About 3 or 4 per cent of men suffer from it. The partially color-blind person can see white, black, and the grays; he can also see blue and yellow, but red and green look alike to him. He therefore finds it hard to distinguish traffic lights; red roses on a green bush have form but not color, or, to be more exact, both have the same color and that is a dull yellow. Still other cases exist in which one of these colors can be seen but not the other. Among these, the green-blind far outnumber the red-blind.

The last fact seems to make it impossible to accept the Hering theory of color-vision, which is the first of the two major theories that have been offered in an attempt to explain certain facts that in its present form the Young-Helmholtz theory does not well account for. We shall accordingly make only brief mention of it. The reciprocal relationship of the sensations of red and green, blue and yellow, as seen both in the negative after-image and in color-mixing, together with the fact that white does not seem to us like a blend but like a primary sensation led

Hering to propound the theory that the retina contains three kinds of receptors in each of which two opposing processes take place, a building-up process on the one hand and a tearing-down process on the other hand. There was first the "brightness receptor" in which one process would give rise to sensations of darker and darker grays tending to black at the maximum, the other lighter and lighter grays with white as the maximum. There was another receptor in which the two processes resulted respectively in sensations of yellow and blue, and a third for the sensations of red and green. The stimulus by which a given process was set in action was, of course, light-waves of a given length, and it was assumed that when the two processes in the same receptor were set in action simultaneously by mixed light-rays, the effect was partial or complete neutralization, which permitted the "brightness receptor" to act more or less independently. But the existence of red-blind and of green-blind individuals seems to make this theory untenable, for a weakness in one receptor should affect both processes in equal degree.

The study of color-blindness also creates an obstacle to an unqualified acceptance of the Young-Helmholtz theory. The question is this: How does the red-green blind person manage to see yellow, if yellow comes from a mixture of red and green? As Hecht points out, the problem may yet be solved by facts that are quite in line with the Young-Helmholtz theory, but so far this has not been done very satisfactorily. A theory proposed by Ladd-Franklin offers a possible solution. According to this theory the retina goes through three stages of development. In the first stage, only white, black, and the grays can be seen. These sensations are aroused by light-waves of all visible lengths. The outer rim of the human retina, as we have seen, always remains in this stage, and there is evidence that the retinas of some animals never progress beyond it. Total color-

blindness is then a state in which development is arrested at this stage. A little later, the receptors become capable of making a differentiated response to light-waves of various lengths. At first, the differentiation is only between the long waves at one end of the spectrum, which then give the sensation of yellow, and the very short waves at the other end, from which there is a sensation of blue. Some individuals remain at this stage; they can distinguish blue from yellow but not red from green; they are the partially color-blind. There is also a zone in the normal retina that remains in this stage. It lies between the outer zone of complete color-blindness and the central zone where there is full color-vision. You can find it in your own eyes by repeating the experiment with the colored papers described on page 237, bringing the papers a little nearer to the center.

Still later a third stage develops. In this the eye, which at first was capable only of coarse distinctions between long and short rays, becomes able to make a further differentiation between the longest waves and those of medium length. The primitive yellow sensation then breaks up into two, as a result of which we have sensations of red (from the longest rays) and green (from the medium rays). When red and green lights are mixed so that the eye is unable to respond to them separately, it reverts to the more primitive stage and gives a sensation of yellow. When blue and yellow in their turn are mixed, the original white sensation is given because this really means a blend of light-rays of all lengths within the visible range.

How does the Ladd-Franklin theory (which, it must be pointed out, is based upon inferences regarding developmental processes from conditions as they exist in the adult rather than from the direct observation of these processes as they occur in the child) check up with the facts so far obtained? By analogy, very well, for as we have seen, de-

velopment in general seems to take place by differentiation of the more gross forms of behavior into finer patterns, and this is just what the Ladd-Franklin theory postulates. The theory also might account fairly well for most of the facts of adult color-vision, including those of color-blindness. But what has the baby himself to say about it?

If we may accept the results obtained by Staples at their face value (and other observations of the reactions of infants to color are in general agreement with them), then it appears that either the theory is in need of revision or the babies are. The fact that the youngest group of infants did not show any reliable tendency to respond to one color more strongly than to another but did respond to colors in general more strongly than to gray might, of course, mean only that they were still in the second stage of development, for we cannot tell whether the red and green looked to them as they do to us. Both may have given a yellow sensation which the babies nevertheless sensed and responded to as something different from gray. But the very marked reactions of the six-months-old children to red, while green as a stimulus appears to lag so far behind, is not in accordance with the idea that the sensations of red and green develop from out the primitive yellow by a process of increasing sensitivity to smaller differences in the length of the light-rays. It may be that a modified form of the Young-Helmholtz theory will after all be found to fit the facts more closely than any one of the more recent theories appears to do.

Theories of color-vision afford a nice illustration of the contribution made by the study of abnormal or defective cases to the understanding of normal behavior. No theory of the mechanism by which color is normally perceived can stand long unless it checks up with the facts gleaned from the study of those people whose color-vision is defective. Hering's theory, as we have seen, fails to meet this test,

and as a result the majority of psychologists no longer accept it. We shall find as we go along that there are many other instances in which the study of the abnormal provides us with a criterion for verifying and extending our interpretations of the principles by which the everyday behavior of normal people is governed. The normal, the abnormal, and the defective all come under the working of the same laws, and a theory that does not account for one cannot adequately explain the others.

There is another criterion, even more valuable because its application is more direct. This criterion is development. You and I are what we are to-day—see as we do, think as we do, behave as we do—because we grew the way we did. No theory, however ingenious, that is contradicted by the facts of development can stand. To attempt to understand the behavior of the adult without looking backward to examine the earlier stages by which this behavior came to its present form is as futile as it would be to try to comprehend our present social, political, and industrial organization or our economic situation without reference to the past.

Chapter XII

EARLY CHILDHOOD

By what factors is the period of early childhood set off from those that precede and follow it?

What are the most striking developmental changes that occur during this period? How do these changes differ in character from those that take place during infancy?

Are the elementary speech sounds, the vowels and consonants, learned by imitation or do they develop spontaneously?

What is meant by "the period of the single-word sentence"?

What are some of the factors that make for superior language development?

How does the study of the language of twins help us to understand the social factors in language development?

What is meant by eye dominance? How early in life is it established?

How does perception differ from sensation?

What appear to be the main characteristics of child logic?

Duration of the Period

As used here, the term of *early childhood* includes the period from the beginning of speech, which in most children occurs at about eighteen months, to the age of five years. Two general considerations have led to this division, namely, developmental change on the one hand and educational and

social practice on the other. As will be shown in the next section, the changes in abilities and conduct that take place during this time are very marked. Moreover, at about the age of five a large proportion of children, particularly in the cities, enter kindergartens.* They are thus brought for the first time under regulations other than those of the home and are faced with the need of adjusting to the demands of a large social group made up of other children. Before entering kindergarten the majority of children have relatively few contacts with companions of their own age. Save for the infrequent twin, brothers and sisters are usually too much older or younger to play together on entirely equal terms, for at these early periods a difference in age of as little as two years counts for a good deal in physical size and strength and mental ability and interests. In many ways the preschool child is a somewhat different type of human being from the baby that he was or the school child that he will presently become.

Characteristic Features of Growth During Early Childhood

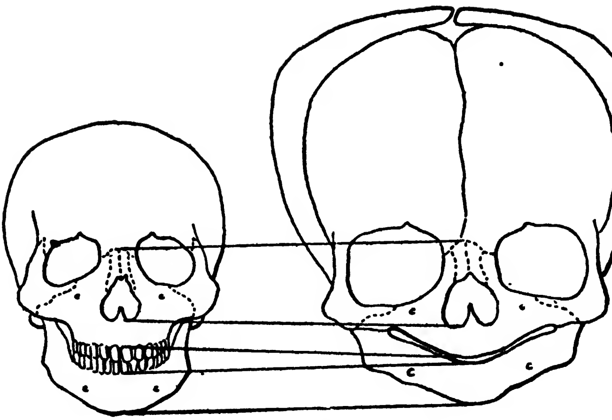
The rapid physical and mental growth that was characteristic of the period of infancy described in the last chapter is continued with only a small decrease in rate throughout early childhood. By the age of five, most of the basic motor skills have been well perfected. The child walks, runs, handles objects, jumps, and climbs almost as well as he will ever be able to do. As his legs grow longer he will be able to run faster, and there will be further gain in speed of movement and in motor control, particularly of the fine muscles of the hand and fingers, but the motor development that takes place after the age of five is very small when compared to that occurring earlier.

* According to the report of the United States Commissioner of Education, in 1930 there were 695,490 children attending public school kindergartens in the United States.

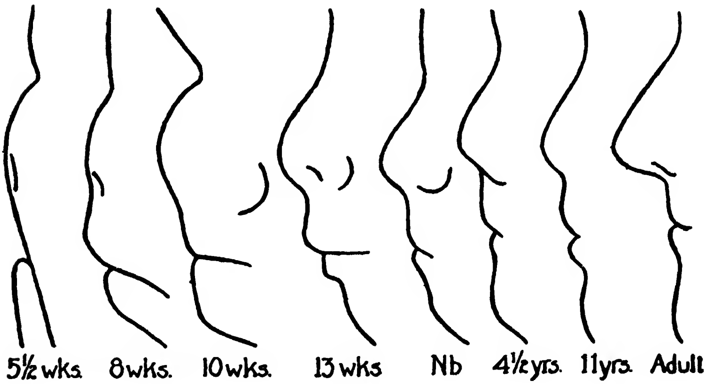
Even more sharply than by the changes in motor development, this period is set off from those that precede and follow it by the acquisition of speech. Before the age of fifteen to eighteen months the average child makes small use of speech. By the age of five he has commonly acquired all the basic speech forms used among adults. He asks questions, makes long and involved statements, uses phrases, clauses, adjectives and adverbs, pronouns, and interjections. His grammatical construction is well-nigh as good as that of the adults with whom he associates and from whom his language has been learned. As he grows older his vocabulary will become larger and his sentences show some further increase in average length, but the basic language forms are all acquired during the preschool period. Articulation, too, is well perfected during this time. In the average child "baby-talk" has become pretty much a thing of the past by the age of five years.

Physical growth is likewise rapid. Up to the age of five years children gain rapidly in height and weight. Their bodily proportions are changing; the arms and legs are lengthening out, the lower part of the face is growing rapidly while the forehead and cranium are making but small gain (see Figure 38), and the features are taking on clearer outlines. After the age of five, growth is less rapid, and it continues at a comparatively slow pace until the prepubertal spurt begins at eleven or twelve years.

Another outstanding feature of growth during early childhood is the emergence of relatively clear-cut patterns of emotional behavior. As was pointed out in the last chapter, the emotional reactions of the very young infant are hard to classify except under the broad categories of pleasure and displeasure. As he grows older, and particularly after he begins to talk, we are able to judge his emotions more exactly because we have more evidence to go by. So in the child of three or four years we see almost unmistakable



A



B

FIGURE 38

CHANGES IN FACIAL PROPORTIONS WITH AGE

A. Skulls of the adult and the new-born drawn to the same face height to illustrate changes in the relative proportions of the neural and facial portions at birth and in maturity.

B. Changes in facial profile from the middle of the embryonic period to maturity.

(After Holl, from chapter on "Developmental Anatomy" by R. E. Scammon in Morris's *Human Anatomy,* sixth edition. Courtesy P. Blakiston's Son and Co.)

signs of rage, jealousy, admiration, affection, egotism, hope, joy, mirth, resentment, and fear. In many ways the period from two to five is the optimum time for studying emotional behavior because during this period the child makes little attempt to conceal his feelings and yet his behavior has become sufficiently complex to make it possible to judge the character of his reactions with considerable accuracy.

Play interests and social reactions take on more highly organized patterns. The baby plays, in a way, but his way is very different from that of the children with whom we are now dealing. Perhaps we can express the difference most clearly by saying that although the baby plays, he does not play games. The nearest approach to a game during infancy is seen in the universal babyhood favorite, "Peek-a-boo," which has a fairly distinctive though simple pattern. Most of the infant's play, however, consists in simple exploitation of his muscles and sense-organs, in activity for its own sake without any set pattern. As a rule, in the so-called "games" played by mother and baby, such as "Pat-a-cake," "How big is baby?" and so on, it is the mother, rather than the baby, who supplies whatever uniformity of pattern exists.

By the age of two, and even before, play begins to take on more organized forms. These forms are at first simple, but they gain markedly in complexity as the child grows older. The two-year-old gallops about the room "toot-tooting" frantically. He is "playing train." The three-year-old elaborates the pattern by interjecting an occasional "ding-dong" for the bell and a "hss-ss" of escaping steam. The four-year-old puts chairs in a row and does his best to induce his companions to assume the rôle of passengers while he, as the conductor, swaggers importantly up and down and takes their tickets. And this is an example of another aspect of behavior that undergoes rapid development during early childhood. Although the infant, as we

have seen, shows definite interest in other infants of his own age and in his behavior toward them exhibits the rudiments of most of the social reactions of the adult, nevertheless these reactions are at best variable and fleeting. He does not depend upon other children for amusement. His play is egocentric. It consists for the most part of experimenting with his own newly discovered abilities. To a great extent this is still the case with the child of two. He shows a kind of gregarious interest in the presence of other children, but for the most part he plays beside them rather than with them. But by the age of four a marked change can be noted. The other child is no longer an incidental accompaniment to his play but has become its chief constituent.

Let us now see if from all these facts we can make any general statement that will characterize the period of early childhood as a whole. The most conspicuous feature of the development of behavior in infancy was shown to be *differentiation,* the emergence of local patterns from the more generalized mass movements of the entire organism. The outstanding characteristic of the growth of behavior patterns in early childhood is *reorganization* of these patterns into new and more complex forms. The baby of four months fixes his eyes on an object that is dangled before him; he wriggles and squirms and opens his mouth, but he does not reach for it though his wildly waving arms may happen to bring it within his grasp. But once the pattern of reaching and grasping has reached a level at which it can occur independently of movements of the rest of the body, the new ability is used in a multitude of new combinations—in climbing, in pulling up to a stand, in handling objects, in securing food, in social intercourse. From the babblings of infancy develop the word forms that the child is able to produce at will and that later on he becomes able to combine in an almost endless number of different ways. Thus he learns to talk. As age advances an increasing number of reactions

take on independence of form and action. Useless movements are eliminated, and the child's behavior becomes more closely adapted to the situation that calls it forth. From now on his chief joy is secured from trying out these new-found abilities in as many different situations as possible.

The beginnings of this process are seen in infancy. As soon as a reaction begins to acquire some degree of independence, it is used not only independently but in new combinations. In this respect the difference between the period of infancy and the period of early childhood is a matter of degree rather than of kind. But in infancy it is the process of differentiation that is the most conspicuous aspect in the growth of behavior; it is through differentiation that the most striking changes in behavior are brought about, even though a considerable amount of reorganization also takes place. With the passage from infancy to childhood the picture changes. Differentiation by this time has progressed so far, the child has so many independent skills at his command and combines them in such an infinite variety of different ways, that such further differentiation as takes place seems inconspicuous by contrast. From now on it is the reorganization and recombination of these basic elements in behavior into new patterns of increasing variety and complexity that will chiefly engage our attention. In the sections that follow we shall consider some of these patterns in more detail.

The Development of Language in Early Childhood

The period of the "trick vocabulary" when the child is able to repeat a few words on demand usually persists for several weeks or even months. During this time he learns new words very slowly and makes small use of those he knows, but he gives evidence of rapid growth in the ability to understand what other people are saying. He responds by pointing to such questions as "Where is the kitty?" obeys

simple commands, squeals with joy when asked if he would like to "go bye-bye." About this time, too, most children develop an amusing conversation-like jargon in which they jabber away for hours at a time. This jargon is far more complicated than the babblings of the younger infant which consist for the most part of simple repetitions of the same sound, most commonly a consonant followed by a broad vowel as "da-da-da-da" or "ga-ga-ga" interspersed with occasional gurglings and squealings. Early in the second year, however, this babbling rather suddenly expands into an expressive jargon in which practically all the sounds known to human speech can be distinguished. This jargon, moreover, is highly inflected. Some syllables are stressed, others slurred over; there are rising inflections as if in questioning, falling inflections that sound like a response. Children differ both in the length of time for which this jargon-period persists and in the extent to which the sounds are elaborated. A little girl of my acquaintance chattered almost incessantly with so natural an inflection and such a wide variety of different sounds that her hearers almost invariably observed, "She sounds exactly as if she were speaking a foreign language!" Although no one, so far as I know, has put the matter to exact test, many people who have been impressed by the great variety of different sounds used spontaneously by children during this stage of development have come to the conclusion that imitation plays a much smaller part in learning to speak than most people suppose. According to this theory the elements of speech, the vowels and consonants and short syllables, are not learned by imitation at all. They develop spontaneously in the course of the child's vocal play. What is learned by imitation is not the mechanical formation of sounds but the *selection* of certain sound-combinations from the rich variety of elementary sound-forms that the child has "taught himself" to pronounce and the *application* of these sound-com-

binations to the particular situations in which he has heard them used by others. So the incomprehensible babbling of the younger child passes over into true speech, not so much by a process of extension as by one of limitation.

Formerly the sight of his well-loved kitty called forth an unassorted jumble of vowels and consonants in all sorts of combinations. One day, perhaps quite by chance, the *k* sound is made. His mother hears it and exclaims in delight. "Just hear him! He's trying to call his kitty!" She repeats the word, "Kitty, kitty!" perhaps picking up the kitten and carrying it to the child as she does so. Now the child does not have to *learn* how to pronounce the sound of *k*. He knows that already; he has been doing it in play for some time. What he has to learn is to use the *k* sound in connection with the "kitty" situation and refrain from using the *g*'s and *s*'s and *m*'s and *p*'s that were a part of his former response. So when the mother selects this sound out of all the rest and holds it up, as it were, for admiration, repeats it, and praises and caresses him for having said it, perhaps crowns the occasion by capturing and presenting him with the elusive kitten that he has been vainly pursuing for some time, all these pleasant experiences operate to bring about a closer connection between the sight of the flesh-and-blood kitty and the utterance of the *k* or, as it soon becomes, the *kee-ee* sound.* This may have to be repeated many times, but sooner or later, as a result of repeated experience in this and similar situations, the great idea dawns. *There is some kind of sound that is the key to every situation. When one utters the right sound, other people obey one's will.* We cannot suppose that the child of sixteen or eighteen

* In the beginning the child commonly uses initial consonants only. Later on final consonants are added, and still later consonants in the middle of words appear. The first words are usually monosyllables, reduplicated monosyllables such as "pa-pa" or "bow-wow," or monosyllables with a single vowel syllable appended, such as "dog-ee," "ta-ah" (tail), "tab-oo" (table).

months formulates the idea as clearly as this, yet that some sort of generalizing process has taken place in his mind and that this idea has come to him rather suddenly seems evident from the marked change in his behavior that takes place within the short space of a few days.

Formerly his attitude toward speech was passive, without definite aim. He babbled and jabbered for his own amusement, showed off his small vocabulary to win social approval.

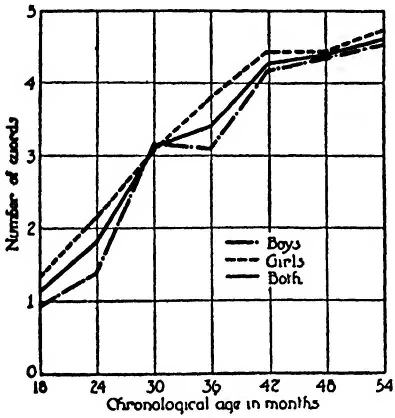


FIGURE 39

CHANGES IN AVERAGE LENGTH OF SENTENCE WITH AGE

(From *Language Development of the Preschool Child* by Dorothea McCarthy. Courtesy of the University of Minnesota Press.)

Now he has become the active seeker after words. He learns that everything has a name. "What's that?" "Who's that?" is his constant demand. No longer need he be urged to show off his verbal accomplishments. He practises them on all occasions. "Baby!" "Doggie!" "Car!" he calls out in delighted recognition when he is taken out for a walk or as he turns the pages of his picture-book. Now his vocabulary grows apace, and as it grows his sentences expand in length and complexity. In his first use of language the single word

is made to serve the purpose of an entire sentence; it is at once subject, predicate, and object—a question, a command, or a statement. "Milk!" calls the baby as he hammers the table with his cup. This is the infantile equivalent of "I want some milk" or "Give me some milk." "Milk," he announces with satisfaction as he sees the arrival of the milkman. This time he is giving information. "Milk?" he inquires with rising inflection as he points to the picture of a bottle in the morning paper. So characteristic is this stage in the development of language that many writers have referred to it as the "period of the single-word sentence."

TABLE 2

AVERAGE SIZE OF VOCABULARIES OF 273 CHILDREN FROM EIGHT MONTHS TO SIX YEARS OF AGE *

AGE IN YEARS AND MONTHS	NUMBER OF CHILDREN	AVERAGE VOCABULARY *Number of Words*	*Average Gain per Month*
0-8	13	0	—
0-10	17	1	0.5
1-0	52	3	1.0
1-3	19	19	5.3
1-6	14	22	1.0
1-9	14	118	32.0
2-0	25	272	51.3
2-6	14	446	29.0
3-0	20	896	75.0
3-6	26	1,222	54.3
4-0	26	1,540	53.0
4-6	32	1,870	55.0
5-0	20	2,072	33.7
5-6	27	2,289	36.2
6-0	9	2,562	45.5

* Adapted from Smith.

Figure 39 shows the average number of words in fifty consecutive remarks recorded by McCarthy * for twenty children at each of the following ages: eighteen, twenty-four, thirty, thirty-six, forty-two, forty-eight, and fifty-four

* Dorothea McCarthy, *The Language Development of the Preschool Child* (Minneapolis: University of Minnesota Press, 1930).

months. Table 2 shows the average size of vocabulary at successive ages as reported by Smith.*

As children grow older their language changes in other ways. Nouns and interjections form a smaller proportion of the total. Pronouns, verbs, adjectives, conjunctions, and prepositions increase in frequency. Table 3 shows the proportion of the different parts of speech at three different ages as found by McCarthy.†

TABLE 3

PERCENTAGES OF THE DIFFERENT PARTS OF SPEECH USED BY YOUNG CHILDREN

Age in months	*Nouns*	*Verbs*	*Adjectives*	*Adverbs*	*Pronouns*	*Conjunctions*	*Prepositions*	*Interjections*	*Unclassified*
18	50.0	13.9	9.6	7.9	10.3	0.5	0.0	7.6	0.0
36	23.4	23.0	16.1	7.0	19.2	2.4	6.9	1.5	0.5
54	19 3	25.1	15.2	7.0	20.5	3.8	7.1	1.2	0.8

Factors Influencing the Development of Language in Children

The talkativeness of the female sex has formed one of the chief stand-bys of the comic papers for generations. Like many other stock jokes, it has some foundation in fact. Nearly all investigators have found that on the average girl babies begin to talk a little earlier than do boys, that their vocabularies at any age are a little larger, and that they use longer sentences. McCarthy found that at the age of eighteen months 14 per cent of the boys' remarks and 38 per cent of those made by the girls were comprehensible to a stranger. At twenty-four months the proportions of comprehensible responses were 49 per cent for the boys and 78 per cent for the girls. In every aspect of language development that has been studied, girls seem on the average to be a little more precocious than boys. (See Figure 39.)

* Madorah Smith, "An Investigation of the Development of the Sentence and the Extent of Vocabulary in Young Children," *University of Iowa Studies: Studies in Child Welfare*, 1926, 3, No. 5.

† *Op. cit.*

Language development is closely related to general intelligence or "brightness." Studies of bright, average, and dull children have universally shown that the brighter children begin to talk at an earlier age than those who are backward, their vocabularies increase faster, as a rule their articulation is better, and they use longer and more correct sentences. Indeed, the quality of a child's speech is one of the chief things by which we are guided in judging his intelligence. (See Chapter XIV.)

Social class is also related to language development. Children from cultured homes not only speak more correctly than those from the lower social classes but their speech is more advanced in other ways. As will be shown later, they also rank higher on intelligence tests, but the intellectual difference between social classes is smaller than the difference in language development. Environment as well as intelligence probably has something to do with it. Figure 40 shows the extent to which children from different social classes differ in respect to average length of sentence. In this figure, Group I represents children whose fathers belong to the professional classes—doctors, lawyers, college professors, and so on. Group II is made up of the children of business men. Group III is composed of the children of clerical workers and skilled tradesmen, and Group IV of the children of semiskilled workers, chiefly factory hands. Group V includes children whose fathers are icemen, drivers of milk-wagons, junkmen, and men following other trades which require little skill. Group VI is made up of the children of day-laborers. At the age of three, the children of Group I use, on the average, more than twice as many words to the sentence as the children in Groups V and VI.

Another example of the way social stimulation affects language development is seen in the development of language in twins. Most children learn their language from persons older than themselves. If there are younger children in the

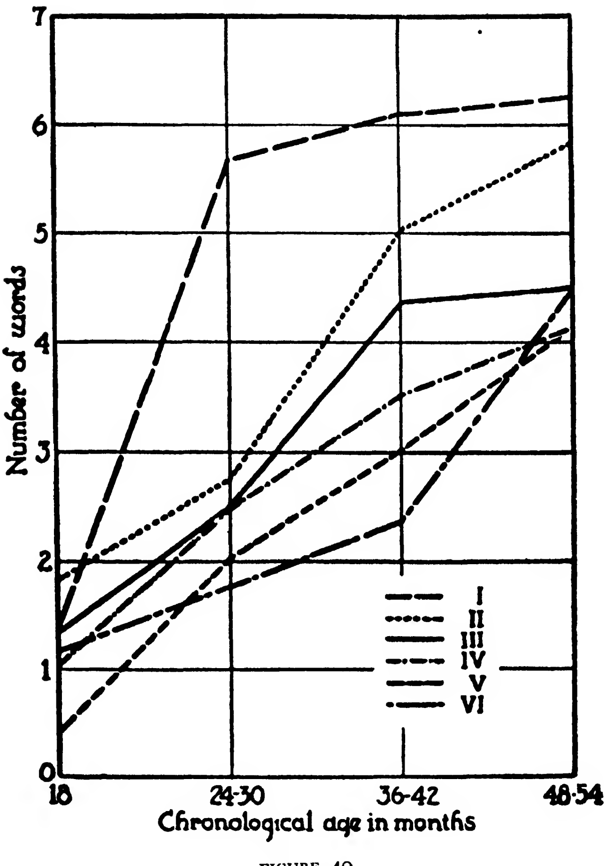


FIGURE 40

RELATIONSHIP BETWEEN PATERNAL OCCUPATION AND AVERAGE LENGTH OF SENTENCE USED BY CHILDREN OF PRESCHOOL AGE

(From *Language Development in the Preschool Child* by Dorothea McCarthy. Courtesy of the University of Minnesota Press.)

family, the difference in age is great enough for the older child to feel his own linguistic superiority to the baby so that he is unlikely to copy the latter's mode of speech. But twins are in a different category. Because of their similarity

of age and interests they spend much more of their time together than brothers and sisters of different ages are likely to do, and for the same reason they are less dependent upon adults for companionship. Twins play together, they talk together, and they imitate each other's speech. There are a number of instances on record in which a pair of twins have developed a language of their own, comprehensible to each other but to no one else. Sometimes this secret language is continued into adult life, but as a rule it is discarded as soon as normal speech is learned. The learning of normal speech, however, is likely to be considerably delayed in these cases. In one such case that I was able to observe, a pair of twin girls four and a half years old used no words at all that could be understood by others. They were unquestionably of normal intelligence. In some ways they were distinctly in advance of their age. To each other they chattered continually, and their behavior gave clear evidence that they understood each other. Yet their language was entirely incomprehensible, even to their parents.

Although the development of an independent language is unusual, Day * has shown that twins, on the average, make slower progress in speech than single children. This retardation is shown in practically all aspects of speech development, in vocabulary, in average length of sentence, and in articulation. Figure 41 shows the extent of this retardation in respect to average length of sentence.

We may sum up, then, by saying that although language development is so closely bound up with general intelligence that it constitutes one of the most important signs by which intelligence is recognized, nevertheless the progress in speech made by any child is determined to a great extent by the kind and quality of the language that he hears. Not only does a child learn to speak a particular language—English,

* Ella J. Day, "The Development of Language in Twins. I. A Comparison of Twins and Single Children," *Child Development*, 1932, 3: 179-199.

German, French, or Chinese—according to the language of the home in which he is reared, but an English-speaking child who hears only good English will himself speak better English than another whose early training has been less fortunate. Children imitate the speech of those about them, whether this speech be good or poor. It is important, there-

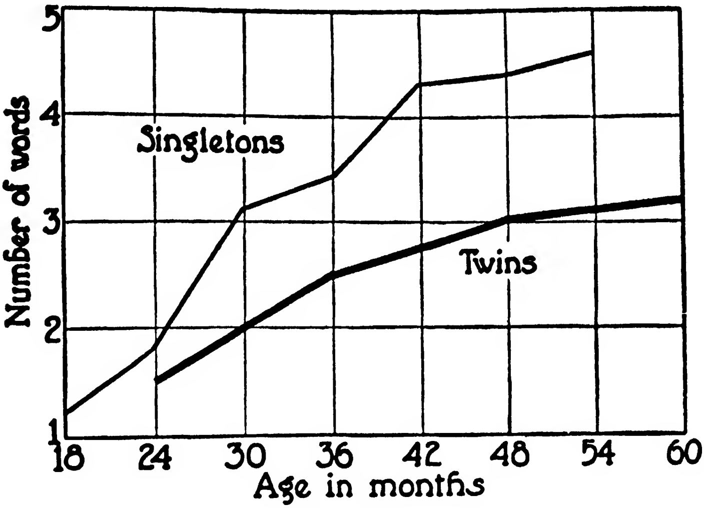


FIGURE 41

LANGUAGE RETARDATION IN TWINS

(From Ella J. Day, "Development of Language in Twins," *Child Development*, 1932, 3: 179-199. Courtesy of Dr. Buford Johnson, Editor.)

fore, that they be given as good models for imitation as possible. Adults should not use "baby-talk" in speaking to children if they wish the children to learn correct articulation. And when children are unavoidably exposed to imperfect speech, as in the case of twins where each hears the undeveloped language of the other, special care should be taken to see that they also get their full share of conversation with older persons and that any specific speech defects

which arise be corrected as promptly as possible in order that mutual imitation may not cause these defects to persist to an age at which they would become a serious handicap. Not all twins are backward in language development. Whether or not they shall be so depends upon the kind of attention and training that is given them in the home.

Language as an Index to Other Mental Traits

Before the beginning of speech we are very often at a loss to interpret the baby's behavior. "If he could only *tell* me what ails him," laments the mother as she tries to quiet her baby's wails, and again, "I simply cannot understand what he wants," as he squeals and tugs at her skirts. But once speech has developed, the relationship of the child to others changes in many ways. It becomes more intimate; its outlines are more clear-cut. Now the child can do more than show that he wants something. He can make requests, ask questions, give commands. He can understand and respond to the requests of others. With the beginning of speech the entire pattern of social intercourse clarifies. Its details as well as its broad outlines can now be seen.

We therefore study and record what the child says in various situations not only as an index to his language development but in order that we may better understand the child himself. When we do this, we find that children differ quite as greatly in the uses to which they put their new accomplishment as in respect to the accomplishment itself. Johnny is continually asking questions. Mary's speech is a succession of commands. Polly uses six *I*'s to every *you.* Billy has little to say about himself but much about the other children.

All these differences have a meaning. When properly understood they throw much light on the total personality of the child. More than anything else in his behavior, the child's language provides us with a key to his character.

Through his answers to our questions and his own spontaneous remarks and questions we are also able to find out something of his thought processes, how he reasons, what he believes. We cannot see the world through the child's eyes without danger of distortion, but after he is able to talk he can give us some idea, imperfect though it may be, of how the world appears to him.

Motor Development

Although walking is begun by most children toward the end of the prelinguistic period, few children become really skilful walkers before the latter part of the second year. The child's first steps are likely to be unsteady, performed with the feet widely separated in an apparent attempt to secure better balance by widening the base of support. Even so it does not take much to upset him, and for some time after walking begins he is likely to revert to the rôle of quadruped whenever the surface of the ground is irregular. However, his interest in walking is so great and he practises it so incessantly that the period of early childhood is often referred to as "the run-about age."

A conspicuous result of the child's rapid gain in motor control is seen in his growing ability and desire to do things for himself. Over and over again comes the insistent demand "Let me do it. *I* want to do that! Let me carry it! I can open it myself! No, don't help me! Let me wash my own face!" At this age the normal child's interest in *doing* is almost unbelievable. Again and again he repeats the same simple action, apparently for the sheer pleasure of producing a result that he can see. Scupin reports that his young son once opened and closed the hinged cover of a box seventy-nine times in immediate succession, and it is probable that careful observation of any normal baby would reveal many similar instances. It is a pity that instead of cultivating and encouraging this worth-while tendency in

young children, many parents are led by thoughtlessness and hurry or by overconcern about the material result to curb the child's attempts to do for himself at the very age when this natural tendency is at its height. Because Johnny's attempts at face-washing stop short some inches in front of his ears and are likely to be interrupted by investigations on the best manner of causing soap-suds to pile up in the basin; because Mary once dropped the cup she had begged to carry; because Peter fails to adjust his cap at the angle his mother thinks most becoming—these are by many parents deemed sufficient reasons for insisting that such things shall be done for their children "until they are old enough to do them the right way." Unfortunately, by that time the urge to do them has too often waned or entirely disappeared.

The most conspicuous changes in motor abilities that occur during early childhood have to do with coördination and balance and with the uses of the finer muscles of the hand and fingers. The child of two can stand and run but he cannot balance himself on one foot even for a few seconds. The three-year-old can stand momentarily on one foot, but he cannot hop on one foot or skip. In watching the behavior of groups of children of different ages in a nursery school, one is immediately struck by the differences in their gross bodily control. The two-year-old moves more slowly and he is more clumsy in seating himself in a chair or in rising from it than the child of three or four. Frequently one sees the child of two or younger back up to a chair and, bending over, carefully inspect it between his legs before venturing to sit down. Apparently he is uncertain how to get himself into the chair unless he is able to see its position. The importance of the eyes in guiding the movements of the body is never so great as when a new act of skill is being learned:

Dexterity of hand improves rapidly. Before the age of

five the average child has learned to feed himself, using spoon and fork, to put on his own shoes, stockings, and other clothing that is not too complicated, to fasten buttons and snaps that he can see. Shoe-laces are likely to baffle him for another year or two, especially when it comes to tying them, and the simultaneous use of knife and fork in cutting meat or the nice adjustment of movement and pressure involved in spreading butter on bread continue to present difficulties.

This improvement in the use of the hands is shown in another way, which illustrates the fact that differentiation of local movements from movements of the body as a whole is not yet completed. As age advances and manual dexterity improves, the child becomes less likely to engage in general bodily contortions along with his hand movements. The little child who is just beginning to draw or write usually goes through all sorts of unrelated movements along with it. He hangs out his tongue and twists it up and down with each movement of his pencil. He moves his body from side to side, contorts his neck, twists his feet around the legs of his chair, breathes hard. As he grows older these accessory movements drop out one by one, and the movements of the hands become more nearly independent of the rest of the body. Age, however, is not the only factor. Practice has something to do with it. Even you and I, when we try to learn a new motor skill, will find some difficulty at first in refraining from useless accompanying activities of other parts of the body. One of the most conspicuous features of the acquisition of skill consists in the dropping out of unnecessary acts that interfere with the speed and smoothness of the motor performance. Motor learning consists quite as much in learning what not to do as of learning what to do.

Hand preference, which began to be apparent during infancy, is well established before the age of five. There is, however, a distinct relationship between the complexity of

the task and the extent to which the hand preference is shown. The right-handed child or adult will commonly use the right hand in preference to the left in reaching and grasping if the object is equally convenient to both hands, but a slight advantage of position will cause him to change to the left. However, if the task is one requiring considerable dexterity, say the manipulation of a difficult fastening, he will use the right hand even at the cost of considerable awkwardness and inconvenience. The development of handedness is most clearly shown in tasks involving complex movements rather than in the simpler ones. The difference between the performance of the two hands is brought about by a steady improvement in the skill of the right hand, while the left shows little change. This is strikingly shown in Figure 42, which is based upon Wellman's * study of the ability of young children to trace a path through an alley decreasing in width from 5 mm. at the start to 1 mm. at the end without coming in contact with the sides.

At the age of three years, the difference in skill shown by the two hands is slight. As age advances, however, the improvement in the performance of the right hand is rapid, in that of the left hand, slow. The right hand gains more in the fourth year of life alone than the left hand gains in the entire three years covered by the study.

It was pointed out in the last chapter that hand preference can be greatly modified by training. Certain psychologists are of the opinion that children whose hand preference has been reversed in this manner are particularly liable to disorders of speech such as stammering or stuttering. The basis for the theory is to be found in the fact that there is a certain area in the brain known as the *region of Broca* which is particularly concerned with the mechanism of

* Beth Wellman, "The Development of Motor Coördination in Young Children; an Experimental Study of Arm and Hand Movements," *University of Iowa Studies: Studies in Child Welfare*, 1926, 3, No. 4.

speech. In right-handed persons this region is on the left side of the brain; in left-handed persons, on the right side. By inference, therefore, it has been thought that any interference with the natural hand preference shown by children might result in a corresponding interference with speech,

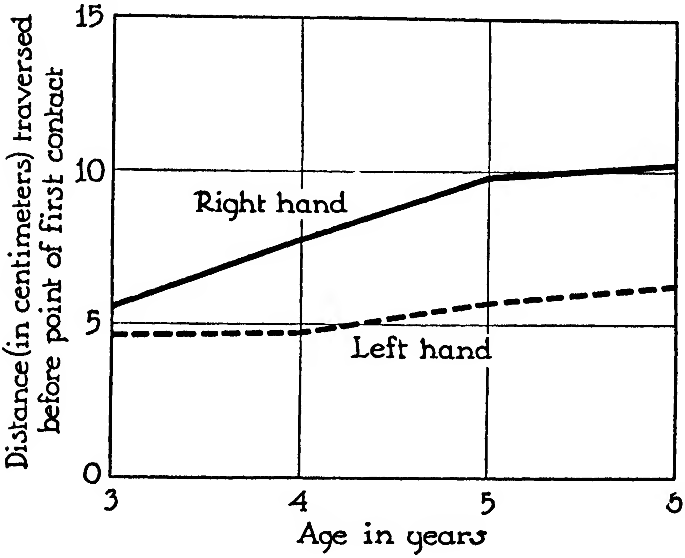


FIGURE 42

COMPARATIVE IMPROVEMENT IN CONTROL OF THE RIGHT AND LEFT HANDS FROM THE THIRD TO THE SIXTH YEAR

(Adapted from Beth Wellman, "The Development of Motor Coördination in Young Children," *University of Iowa Studies: Studies in Child Welfare,* 1926, 3, No. 4. Pp. 93.)

since the two are so intimately associated. Many investigations have been conducted in the attempt to test this theory. Many persons have attempted to correct stuttering either in themselves or others by changing to the use of the left hand in all major performances. In some of these cases the speech defect has improved or disappeared, in others no

change could be observed. As a whole the evidence is not very convincing, for it is well known that suggestion alone, if sufficiently powerful, will sometimes correct nervous disturbances of this kind. Moreover, if a young child is continually nagged, scolded, and perhaps punished for the use of the left hand, and this just at the time when speech habits are being formed, it is entirely possible that disturbances of speech may result as a consequence of the effect of such unwise treatment upon the entire nervous organism, rather than because of interference with any local brain mechanism. In such cases a change to the use of the originally preferred hand some years later would not be likely to do any good. However, because it is always unwise to interfere unnecessarily with natural developmental traits, it would seem to be the part of wisdom not to insist too strongly upon the use of the right hand when the preference for the left seems very pronounced.

Handedness is not the only way in which the dominance of one side of the body is shown. Not only do we use one hand in preference to the other, but in ordinary near vision we "sight" with one eye in preference to the other. This can be demonstrated in a number of ways, but one of the simplest and most convenient methods is by use of a little device called a *manopter* (also known as a *manoptoscope* or *V-scope*), devised by W. R. Miles. You can easily make one by folding a good-sized sheet of stiff paper so as to form a flattened cone, wide enough at the large end to enclose both eyes and tapering to an opening about one inch in diameter at the other end. The cone should be about nine inches in length. Now if you stand at a distance of about ten feet from the person whom you are going to test for eye dominance and instruct him to hold the V-scope to his eyes with both hands, and to look through the large end at a small card or other object which you will hold directly in front of your face you will find that only the eye with which

FIGURE 43

THE MANOPTOSCOPE METHOD OF DETERMINING EYE DOMINANCE

Note that, although the subject thinks he is using both eyes, only the dominant eye can be seen through the small end of the cone. In this case the subject was instructed to look directly at the lens of the camera.

(From W. R. Miles, "Ocular Dominance in Human Adults," *J. Gen. Psychol.*, 1930, 3: 412-430. Courtesy Clark University Press.)

he is sighting can be seen through the small end of the V-scope which is toward you. Record whether this is the right or left eye and repeat the experiment about ten times to see how consistently he uses the same eye. It is a good idea to use different cards or objects and ask him to tell you what they are, not only to make certain that he is looking in the right direction but also to keep him from suspecting the real object of the test. (See Figure 43.)

How early in life does eye dominance appear? Updegraff * has reported the results of a study of 190 children between the ages of two and six years. These children were given repeated tests at intervals varying from two months to two years. In this way, not only could eye dominance at a given time be studied, but also the persistence of the trait over a period of time could be observed.

It was found that only a small percentage of the two-year-olds showed definite eye dominance. However, by the age of three more than 75 per cent of the children not only used the same eye very consistently throughout a single series of ten trials, but on a second test given two months later no change in "eyedness" had taken place. They continued to sight with the same eye they had used before. Of the children who showed no definite eye dominance at the age of three, about 75 per cent had become definitely right-eyed or left-eyed by the age of five or six. Studies of older persons have shown that a small percentage of cases (most investigators have found fewer than 5 per cent) remain "indefinite-eyed" throughout life, that is, they sight sometimes with the right eye and sometimes with the left.

Eye dominance then seems to be established in most children somewhere between the age of two and three years. In some cases it occurs earlier and in some not until several years later, while a few people remain indefinite-

* Ruth Updegraff, "Ocular Dominance in Young Children," *J. Exper. Psychol.*, 1932, 15: 758-766.

eyed throughout life. Updegraff found not only that the percentage of indefinite-eyedness decreases with age but that changes in eye dominance occur somewhat more frequently in young children than in older ones or in adults.

Right-eyedness, like right-handedness, is more common than left-eyedness, but the difference is less marked than in the case of the hands. At all ages after three years, from 60 to 70 per cent of all people are right-eyed, but more than 90 per cent are right-handed.

It is difficult to explain the facts of eye dominance on any other basis than that of some inborn tendency. The fact that it is relatively late in showing itself proves nothing, for many inborn traits, e.g., the growth of whiskers in the male, do not appear until some time after birth. The fact that most people are entirely unaware of eye dominance either in themselves or others affords some evidence that the condition is not likely to have been brought about by training. In one sense, eyedness and handedness may be said to go together, since the right side is commonly superior in both traits, but whether left-handed people also tend to be left-eyed is still open to question. At least the relationship is not invariable, either in children or adults.

"Footedness" has also been studied, but the findings are less clear. The two feet are not often used independently of each other, and when both participate in an act, even though they play somewhat different rôles, it is often hard to say which is taking the chief part. Such investigations as have been made seem to indicate that foot dominance is not as clearly marked as either eye or hand dominance, and that it varies more from one activity to another in the same person. However, this may be because our techniques for studying it are poor.

FIGURE 44

MATCHING THE LENGTH OF LINES ON THE GALTON BAR

By turning the crank the subject is able to change the length of his line until he judges it to be the same length as a standard line which he is trying to match It has been found that by the age of five years. children are able to match lines with an average error that is only slightly greater than that made by adults The ability to compare lengths improves very rapidly between the ages of three and five years.

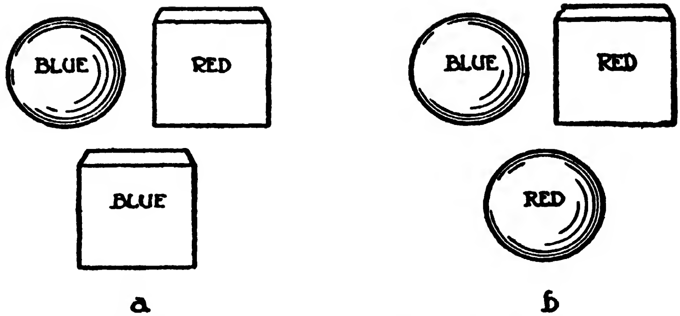
(Photography by courtesy of the University of Minnesota Institute of Child Welfare.)

Sensation and Perception

As far as we can judge from his behavior, before the end of the first year the child's sense-organs are functioning as well as they ever will. As a result of his growing experience he soon learns to interpret most of the simple impressions he receives through his senses with a high degree of accuracy. Careful experiments have shown that by the age of four or five years, children will react to distance by reaching to the correct point, will match lines of different length, and will choose the heavier of two weights almost if not quite as exactly as adults. (See Figure 44.)

But we must not fall into the error of supposing that, because simple perceptual skills such as these have approached the adult level of development, the world as a whole looks to the child the same as it does to the adult. A simple experiment will illustrate. When children of different ages are shown, one at a time, a series of colored geometrical forms—stars, circles, squares, and the like—and are asked in each case to choose between matching the figure with another similar in form and size but differing in color, or with one of the same color but differing in form, it has been found * that children under two and a half years usually match on the basis of form. At about the age of two and a half or three years a swing toward color appears. Thereafter an increasingly greater percentage of the matchings are made in terms of color, ignoring differences in form, until a maximum preference for color is reached at about the age of four and a half. Then the tide of interest again turns. Form and not color decides the issue in more and more of the choices until the adult level is reached, at which time about 90 per cent of the matchings are made in

* C. R. Brian and F. L. Goodenough, "The Relative Potency of Color and Form Perception at Different Ages," *J. Exper. Psychol.*, 1929, 12: 197-213.



Illustrating Placement of Forms Before Child

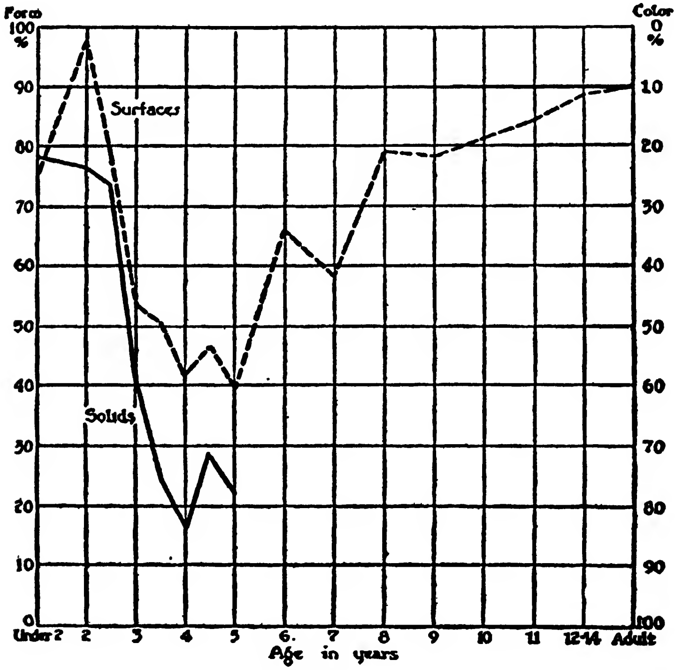


FIGURE 45

AGE CHANGES IN COLOR-FORM PERCEPTION

(From C. R. Brian and F. L. Goodenough, "The Relative Potency of Color and Form Perception at Different Ages," *J. Exper. Psychol.*, 1929, 12: 197-213. Courtesy of Psychological Review Co.)

terms of form and only 10 per cent in terms of color. (See Figure 45.)

The question of how objects and relationships are perceived and why certain errors in perception occur has attracted much attention from psychologists for more than half a century. It has long been known that by combining lines and angles in certain ways, very deceptive visual effects can be produced. An example is shown in Figure 46.

FIGURE 46

THE TWISTED CORD ILLUSION

(After Fraser.)

Another interesting feature of visual perception is illustrated by Figure 47. This figure is commonly known as the ambiguous staircase. If you look at it steadily for a time, the entire figure will suddenly seem to change its position and to appear in reversed perspective. These alternations will recur at fairly short intervals. Many other straight-line representations of geometrical solids show this tendency to reverse themselves when looked at steadily for some time.

The exact reason for these and other illusions which are experienced by all normal adults is still uncertain. Habits formed in the visual exploration of space and in the utiliza-

tion of eye-movements in judging distances probably have something to do with it. Another explanation is to be found in the universal tendency to see things as sensible wholes. As we have pointed out before, it is doubtful whether there can be any sensation, any personal experience, which is not first of all perception. We do not merely see, but we see something; we not only hear, but we hear

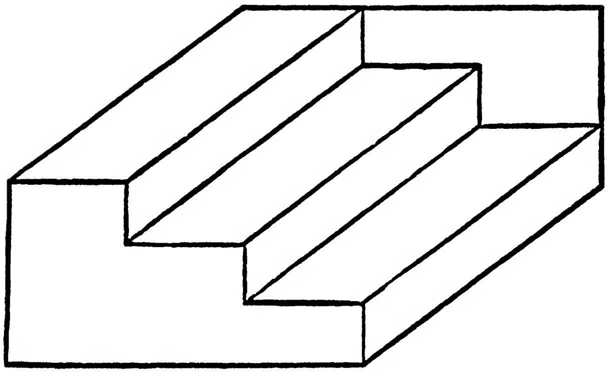


FIGURE 47

THE AMBIGUOUS STAIRCASE FIGURE

If you look attentively at this figure for a time, the perspective will appear to reverse itself so that the stairs will be seen as if viewed alternately from the front and from the rear.

something, and so with the other sensory fields. We may not know what the "something" is. Its form and structure may be so weak that it changes continually, but it always maintains some kind of internal unity and coherence.

The most significant phases of the development of perception normally take place in early infancy, long before children can describe them. However, the first visual experiences of persons blind from birth whose sight has been restored by operations performed after they were grown up have been reported in a few instances. In the beginning

few details of objects are seen. Objects and persons appear like lumpy indefinite shapes whose contour changes with changing visual regard. But they are always totalities; not mosaics made up of little bits. With practice in seeing, more details emerge and the outlines of the seen objects become more definite and stable.

To what extent the growth of visual perception in the infant parallels that in the adult who sees for the first time is uncertain, but it is unlikely that the two are identical. The adult, even though he has never seen, has formed a good many concepts about the world and the things in it. Ideas of distance, of spatial extent, of form as perceived by touch, and of hosts of other things that the infant has yet to learn are already familiar to him. He looks at his new world with these ideas in mind. Since much of what we think we see is really not seen at all but only inferred from what we already know, the adult who sees for the first time has a good many ready-prepared aids in seeing intelligently which the child lacks.

Previous knowledge about a thing has a great deal to do with perception. We perceive things as we know they are or as we think they should be, and we overlook much that is there but that does not fit into our preconceived pattern. Persons inexperienced in proof-reading find it difficult to see typographical errors unless they are very glaring. Careful experiments have shown that even persons with excellent hearing actually *hear* only about 75 per cent of the sounds in an ordinary conversation. The gaps are filled in by means of the context, and the listener is so unaware of the process that he cannot tell which parts he actually hears and which he supplies. He thinks he hears it all. This tendency to fill in gaps, to complete every experience and make it into a perceptual whole, shows itself in many ways. Little children just learning the alphabet frequently confuse the letter C with the letter O. The C to them is a broken O; they fill

in the gap without knowing it, and the C becomes an O. But once they learn to identify the C as a C, the broken circumference becomes an integral part of the thing perceived. It is no longer an accident to be overlooked but an important part of the new picture. When this stage is reached, the letters are no longer confused.

Whatever else perception may be, it is always an act of integration, of the construction of meaningful wholes. When elements that seem necessary to complete a perceptual unit are lacking, they will be supplied if the gap is not too great; when discordant elements are present, they will be overlooked or pushed out of the picture into the background or the whole scheme may be remodeled to fit them into it.

Perception is built up from experience. Since experience varies, perception will also vary. Two persons may have equally acute sense-organs and be equally capable of responding to any feature of a situation, yet they will rarely gain exactly the same impressions from it. One gives attention to this, another is attracted by that, a third ignores both these features and sees instead something that was overlooked by both the others. Could we but put ourselves in the place of the child of three or four years, we should probably find that the world looks to him very different from the way it appears to an adult, and that the impressions he receives from any situation are in many ways quite unlike those that you or I would be likely to gain under the same conditions. What is seen and heard by any person, whether he be child or adult, is quite as much a matter of his past experiences, his interests and attitudes, his modes of thought as it is a matter of his eyes and ears. It will pay us, then, before going further to try to get some idea of the child's early conceptions of the world and its workings, at least to the extent that his limited vocabulary enables him to describe them to us.

Thought and Reasoning in the Young Child

Some kind of primitive notion of cause and effect seems to be born in the child's mind very early. Any activity gains in interest for him if it terminates in some result that he can hear or see. When experience has taught him what this result is likely to be, the tense interest with which he watches to see his expectation fulfilled and his shrieks of delight when the expected event occurs have been noted by almost every observer of child behavior. The recurrence of the familiar, the fulfilment of expectation, affords him much keener joy than he finds in novelty. In these unverbalized ideas of the association of events lie the beginning of generalization, the germ of the mental processes that at a later age we call judgment, reasoning, thought.

Both forward and backward associations or, if we choose to use rather high-sounding terms, both inductive and deductive logic are used by the small child long before he is able to distinguish or describe the processes by which he arrived at his conclusions. "Where are you going?" asks the three-year-old, as he sees his mother put on her hat. This is a forward association, a bit of childish deduction based on his experience that the putting-on of a hat is the usual forerunner of going out. "The horsie falled down!" anxiously exclaimed a little girl of three the first time she saw a horse lying in a field. In her experience horses always stood erect, hence her deduction (which may have been based in part on her observation of toy horses) was natural enough.

Although children show by their behavior and spontaneous remarks that they are reacting to certain observed relationships, they do not at these early ages put these ideas of relationship into words. This is well shown in an experiment reported by Heidbreder.* In this experiment it was found

* Edna Heidbreder, "Reasons Used in Solving Problems," *J. Exper. Psychol.*, 1927, 10: 397-414.

that children of three and four years had little difficulty in learning to react correctly to a general feature in a simple situation but that they could not, as a rule, describe the principle to which they were reacting. When the problem consisted of choosing the one of two boxes which contained a small doll and the solution lay in always taking the nearer box, regardless of its markings or of whether it was placed on the right or left of the subject, children who had learned to choose the correct box without hesitation could not formulate the reason for their choice. When urged to tell why they chose that particular box, they could not, as a rule, get beyond such vague statements as "Because I took it," or "I just knew it." Often the time sequence of ideas was reversed, that is, the reasons given were in terms of events occurring after the choice had been made, such as "Because I opened it and saw her."

The generalizations of the child under five appear to be narrow rather than broad. Two facts are connected in such a way that the child is able to react to the relationship between them rather than to the facts separately. Instead of choosing a particular box, he selects the one that is nearer or the one that is darker in color or the one that is at his left. But he does not organize a whole group of facts under one general law that he can express in words, although he sometimes gives evidence of a vague groping toward such generalizations. Upon the whole, he particularizes rather than generalizes.

Chapter XIII

THE SOCIAL AND EMOTIONAL BEHAVIOR OF YOUNG CHILDREN

How does the development of language affect the child's social relationships?

What are the chief factors that make for leadership?

Are leaders "born" or "made"?

Do all new emotional reactions arise through direct conditioning? What new sources for the establishment of emotional responses appear in childhood that were not present in infancy?

What is the psychoanalytic view of children's emotions?

What is meant by a mental conflict? Why do conflicts sometimes give rise to unexpected forms of behavior?

Can anything be done later on to correct undesirable forms of behavior or emotional attitudes that have arisen through unfortunate experiences during childhood? Illustrate.

Social Behavior and Language Development

Even in babyhood, children differ in the way they react to others. After speech has begun these differences are easier to see and to describe, for language is not only an important form of social behavior in itself, but the child's words give additional meaning to his actions. By the use of speech he is able to influence the behavior of others in a host of direct ways, in comparison with which his earlier language of gesture and expression seems pitifully inade-

quate and clumsy. This is particularly shown in his relationships with other children. He does not learn the possibilities of his new tool all at once, but as he grows older we find that an increasingly greater proportion of his conversations with children of his own age are directed toward modifying their behavior in some way. He gives more commands, offers more suggestions, makes very many more criticisms, asks more questions. Now for the first time, qualities of leadership appear in almost unmistakable form.

The Child Leader

What causes some children to be leaders of their groups, while others rarely show qualities of this kind? About all we can say is that there appears to be no one factor which will guarantee that any given child will develop into a leader but rather that certain groups of characteristics in the child himself, in combination with certain kinds of external circumstances, favor such development. Let us first turn to the personal qualities of the child leader.

A group of four-year-olds were playing house in a large packing-box. They had built a number of crude pieces of furniture out of their blocks, but as space within the box was limited it was necessary to move about with extreme caution in order to avoid knocking things over. Clumsy and excitable Jimmy found this well-nigh impossible. After half a dozen accidents, the "father" of the family announced in the tones of one who has just made a thrilling discovery, "We gotta have a dog, too! Jimmy, you be the dog! You have to stay outside and bark whenever anybody comes by the house. Bark *loud!*" A place had been found for Jimmy, and he entered into his new rôle with energy and enthusiasm.

In this little incident is exemplified what is perhaps the most important attribute of the successful leader of any age or level of development: ability to recognize the special

abilities and limitations of others, together with versatility in devising rôles into which these characteristics will fit. Too, the able leader usually shows a knack for depicting these rôles in such glowing colors that the person for whom they are designed will not merely agree but will actively desire to accept them. The "bark loud" in this case was a stroke of genius. It provided Jimmy with just the outlet for his overflowing energy that he needed. So in later years the person who is full of ideas that meet the needs of his associates and who can present his ideas in attractive terms is more likely to be sought for and to have his plans accepted than is another whose ideas, though equally good in the abstract, are not so well suited to the individual interests of the members of his group, or a third whose ideas may be both good and suitable but who is unable to present them in vivid and forceful terms.

The story of Jimmy illustrates still another point. All other things being equal, the successful leader is the one who is able to foresee and forestall dissension among the members of the group without losing any one from the ranks. One way of disposing of Jimmy would have been to put him out of the group. Indeed, a number of the children had already begun to demand his expulsion. But the little "father" 's solution of the difficulty not only retained Jimmy among his followers but also, it is safe to assume, increased the solidarity of the group, for any one is likely to be loyal to a leader who assigns him an important position. Surely no one can deny that the presence of a loudly barking watchdog lends stability and importance to any household!

When we observe the great differences in the ability to lead and manage others shown by different people, we can hardly avoid asking how these differences came about. Are some people just "born leaders," or is leadership learned by experience? We do not know. It is unquestionably true that children show marked differences in social traits such as this

very early in life. Yet it is also true that their social experiences differ from the very beginning, and many of these differences are of a kind that might be expected to affect their habits of social behavior. Before they enter school, some children find that the most effective way for them to manage the people about them is by means of temper tantrums or whining or teasing. But later on when they try these same methods with their classmates and teachers they find them less effective. Of course they can learn to use other methods, but meantime their playmates who have already worked out better techniques of social intercourse have gained a considerable start. The child who has learned in his own home the patterns of social behavior that make him popular with his fellows presumably has an advantage over the one whose early experiences have been of a kind to foster selfishness, lack of coöperation and stubbornness, or over another who has been so repressed and dominated that he shrinks from social contacts of any kind; but just how great this is we cannot say. A good beginning unquestionably counts for much, and this is particularly true in matters of social interaction where one's own behavior so largely determines the kind of response that will be made by others. The child may get by with behavior of a kind that is annoying to others as long as he remains in the home, but elsewhere it is a different story. Some children solve the problem by building up two fairly distinct sets of behavior, the one for use at home with the family and the other for the rest of the world. Others, less adaptable or more sensitive to rebuff, withdraw from the group, become shy, self-conscious, and awkward in the society of other people. Unless something happens to revive their self-confidence, a vicious circle is likely to be formed in which when their non-social behavior meets with rebuff they respond by withdrawal, this in its turn inviting forgetfulness and apparent slights on the part of others. Thus the slighted

individual becomes still more seclusive and solitary. Here again we see how closely the emotional experiences connected with behavior are bound up with the development of the whole personality.

Emotional Development in Early Childhood

Like other forms of social behavior, emotional episodes also become easier to describe and classify after the child begins to talk. Moreover, now that he is able to understand the speech of others, a new and very important basis for emotional reactions is provided. During infancy his emotions could be aroused only by means of things done to him or in his presence. Now he can be made angry or afraid or sympathetic or jealous through things that are said. From now on, emotional responses will often appear that seem quite inexplicable to his elders who have not followed through the course of his childish reasoning.

A little boy, not quite three, was very fond of being taken to a near-by lake to bathe. He showed not the slightest fear of the water and delighted in being taken far out from shore by his father, who was an expert swimmer. One day he was taken fishing in the same lake and this too he appeared to enjoy greatly. He sat in the boat, "fished" with a light rod, and shrieked with glee when he succeeded in catching a small fish. A few days later he was again taken swimming. To the amazement of every one he refused, with every sign of fear, to go near the water. His father finally undressed him by force and attempted to carry him in, but no sooner had his feet touched the water than he began screaming in such extreme terror that it was thought best not to force or urge him further. He could give no explanation of his fear at the time, but a few days later he confided to his mother, "Mummy, do you know why I couldn't go in ze water one day? I was apraid ze pish would bite my peet [afraid the fish would bite my feet]."

His reasoning was simple enough. On the fishing trip there had been much talk of the way the fish were "biting." At the time this did not trouble him, for he was safe in the boat and the fish were in the water. But the next time he was called upon to go into the water with nothing to protect his "peet" from the biting fish, the situation was entirely different. Fear appeared, and not, it should be noted, through the mechanism of simple "conditioning" but through a more complicated intellectual process. So as understanding grows, emotional reactions also grow and change. New information may give an entirely new meaning to any object or situation, making fearful that which was formerly enjoyed, turning annoyance into pleasure, likes into dislikes, admiration into disgust.

Once speech has been established, an increasingly greater number of our emotional reactions are brought about through its means. Sometimes the relationship is simple and direct. The mother tries to secure obedience by telling the child that if he fails to do thus and so, the policeman will catch him and take him away. As a result he develops a fear of policemen. On the other hand, children sometimes develop unexplained fears when every effort has been made to protect them from frightening tales or experiences. Often these fears are built up on what is to the child a perfectly logical process of reasoning, from bits of information or partially understood remarks that in themselves were harmless enough but which to the child suggested a terrifying meaning. Before the development of speech, conditioning probably accounts for most of the specific fears that a child shows. After speech begins, fears and other emotional reactions may arise in many other ways, in which the intellectual factors of understanding and misunderstanding play an increasingly greater part. These emotional reactions may persist throughout life, long after their origin is forgotten. If all were known, it would probably be found that

most of us carry about with us a store of likes and dislikes, dreads and anxieties, superstitions and phantasies that have their root in meanings established in early childhood.

The Psychoanalytic View of Children's Emotions

Recognition of the importance of the meanings that grow up about the emotional experiences of early childhood led Dr. Sigmund Freud, a Viennese physician specializing in mental disorders, to formulate the principles of what is now known as psychoanalysis. According to the psychoanalysts, most of the mental disorders that have no ascertainable organic base, as well as most of the persistent worries, fears, and anxieties to which the majority of us are subject in greater or less degree, are traceable to certain suppressed desires. At the outset these desires are suppressed by the direct action of father, mother, and others in authority, but very soon they are suppressed by the child himself, by the ideas of what is and what is not socially acceptable that develop in the course of his experience. Freud contends that there are only two really strong impulses by which all people are dominated, the impulse for self-preservation and the sex impulse. Now the impulse for self-preservation is generally recognized as something respectable and even desirable, so that no one interferes very much with its free expression. But sex is different. Very early in life the child is taught that sex, the sex organs, the parts surrounding them, and all things relating thereto are tabooed subjects of conversation in polite society. You may protest that this should not make any very great difference to him because the sex impulse is normally not very strong in the years before puberty, but here the psychoanalyst would not agree with you. The sex impulse in childhood, they will admit, is less definite and specifically localized than it will later become, but it is assumed to be present and strong. So in early childhood each little boy is said to fall in love with his mother and to

be highly jealous of, perhaps even to hate, his father, while each little girl loves her father and resents having to share his love with her mother. Here we have the much-talked-of Œdipus complex (named from the Greek tragedy *Œdipus Rex*) in the case of the boy, while its feminine counterpart is known as the Electra complex.

Because sex and all things associated with it are represented to the child as something wrong and shameful, he is forced to relegate them to a rather mysterious part of the mind known as the "Unconscious," a mental domain which, because of its vast importance in psychoanalytic theory, deserves to be capitalized. There sex ideas are held down by the "Censor," a name applied to the attitudes toward these matters that social pressure has forced the child to take. But the Censor has only limited power. It may consign sex and all its devilish works to the realm of the Unconscious, but they don't stay put. Instead they merely don enough of a disguise to deceive the Censor (who seems to be rather easily fooled) and thereupon break loose in all sorts of ways. Nail-biting, thumb-sucking, even lying and stealing, according to this point of view, are likely to be nothing more than manifestations of the sex urge that have chosen this way of evading the Censor.

Like many another promising train of ideas, the theories of psychoanalysis have lost much of their significance by being shunted off on a single track. It is not necessary to postulate any special mental compartment such as the Unconscious to understand that meanings may persist and continue to determine behavior long after one has forgotten how these meanings came into existence. Your own memory does not tell you how you learned that a chair is something to be sat upon, that it is pleasant to eat an apple and unpleasant to eat pepper. Nevertheless you react to these present meanings without hesitation. So all sorts of early experiences may give special meanings to particular situa-

tions, and if nothing happens to change these meanings they may continue to dominate one's behavior throughout life. In all this there is nothing mysterious, nothing that requires a special explanation outside the general laws of human behavior. According to this point of view, the Unconscious is nothing more than the forgotten emotional experiences that originally gave rise to the meanings by which our present behavior is governed.

Let us now have a closer look at the Censor. The first thing that strikes us is that he is not so stupid as he has been represented. So far from being fooled by the pestiferous tricks of the illicit impulses he has penned up, he connives with them in devising forms by which they can appear in decent society. But Freud was mistaken in supposing that sex impulses are the only ones that must don false mustaches and checkered suits in order to conceal their identities. Years ago, G. Stanley Hall * pointed out that few if any of the primitive emotions are permitted free expression under modern conditions of civilized life. Take anger as an example. You do not as a rule give the waitress a black eye because she puts her thumb in the soup, but you may refrain from giving her a tip. When one of your classmates offends you, you are not likely to attack him with your fists, but you may make a sarcastic retort. In like manner, fear, jealousy, or other emotions when experienced under such conditions that the primitive response would fall under the social taboo are likely to find some kind of substitute expression. The process of substitution begins very early. A little boy not yet two when restrained from investigating the contents of his father's pockets ran screaming to the floor lamp, jerked at the cord and pretended he was going to tip the lamp over. A little girl of about the

* G. Stanley Hall, "Anger as a Primary Emotion and the Application of the Freudian Mechanisms to Its Phenomena." *J. Abn. Psychol.*, 1915, 10: 81-87; "The Freudian Methods Applied to Anger," *Amer. J. Psychol.*, 1915, 26: 438-443.

same age when punished for some small misdemeanor pulled all the cushions off the davenport. Somewhat later the day-dream comes in as a form of substitution for emotions that are denied more active expression. In the day-dream you are exalted, while the rival who has made you angry or jealous or afraid is made to suffer all the punishment that you were unable to inflict at the time.

Most psychoanalysts would consider this idea of the Censor very superficial. They prefer to regard the suppressed motive or desire as one so sternly frowned on by the Censor that it can escape into action only by the adoption of a disguise so clever that it cannot be penetrated even by the subject himself, except by a long and complicated system of "analysis." So it takes the form of such unusual and bizarre substitute activities that no one, not even the person himself, recognizes them for what they are.

That cases occur in which the behavior of the individual seems entirely inappropriate to the situation that calls it forth is unquestionably true. Nevertheless it seems improbable that the Censor (that is, the social and ethical standards of the group to which one belongs) does anything more than prevent free discussion of matters which would never have become sources of disturbance if they had been properly understood at the time. Behavior that to an outsider seems queer and unreasonable may be simply the result of misinterpretation of what is happening. Children are particularly liable to such misunderstandings because of their limited knowledge and experience. Because discussion of sex matters is of all subjects most likely to fall under the social ban, the child who by accident comes in contact with some fact of sex to which he attaches a wrong meaning is likely to remain in a state of misunderstanding which may influence his behavior in all sorts of unexpected ways. For example, a number of cases have been reported in which children developed strange fears or anxieties about some

apparently trivial matter after the birth of a baby brother or sister. Investigation has usually shown that in these cases the child was unprepared for the baby's coming and that no adequate explanation for the event was given him afterward. All that he knew was that his place in the household had suddenly been usurped by this strange baby upon whom all the attentions that he had been accustomed to receive were then lavished. Just as the fear response to a loud sound may be transferred through conditioning to almost any kind of originally indifferent object, so it sometimes happens that the distress, bewilderment, and anxiety aroused in this way may become attached to some apparently insignificant object or activity that happens to have been associated with the situation. Woolley * has described a case in which a little girl, not yet four years old, shortly after the birth of a baby brother developed an extreme fear of coming down stairs. It was noteworthy that the fear was associated only with stairs having a certain pattern of banister-rail and that the fear was never shown in connection with going up stairs, but only with coming down. It was found that the stairs in the hospital where the baby was born were like those of which she had become afraid, that when taken to the hospital by her father to see her mother and the baby they had been accustomed to go up in the elevator but to walk down the stairs when leaving, and furthermore that although no explanation or preparation for the baby's coming had been made to her, she had asked no questions about it at home. This last fact had surprised the parents considerably, since the child was exceptionally bright and was accustomed to inquire into the whys and wherefors of everything that came under her observation. That her silence was due to fear of reproof or punishment for questions on a subject that experience had taught her

* H. T. Woolley, "Personality Studies of Three-Year-Olds," *J. Exper. Psychol.*, 1922, 5: 381-391.

was socially tabooed rather than to lack of curiosity or interest seemed evident from a number of remarks made to her teacher at the nursery school which she was attending. Repeatedly, with a puzzled face she had made such comments as, "When my mother went to the hospital she didn't have a baby. When she came home she had one." Apparently the matter was causing her a considerable amount of concern and anxiety. The apparent mystery surrounding the whole affair presumably contributed to the child's feeling of uncertainty and insecurity, a feeling that was readily transferred to the first object that met her eyes on leaving the mother's room at the hospital.

This incident shows how matters relating to sex may become especially potent sources of conflicts and worries in young children simply because of the attitudes taken by their elders. It is not necessary to assume that the child's own sex feelings and attitudes are involved at all except in the very broad sense of his family affections and his personal status in the household.

One may ask further how this little girl had managed to learn at so tender an age that sex matters are not topics for questions or discussion. It is very improbable that she had learned anything of the kind. It is unlikely that the birth of the baby had any connection in her mind with other matters which she had presumably been taught were forbidden topics, such as her genitalia, or anything pertaining to urination, defecation, and so on. But if she had repeatedly found the older members of her family engaged in engrossing conversation which was suddenly stopped when she entered the room, if apparently meaningless remarks were accompanied by significant glances, and if, later on, she found all this air of mystery centering about the new baby and its arrival, it would be indeed strange if an intelligent and sensitive child were not to grasp the idea that here was a topic about which questions would not be wel-

comed. Only to the grown-ups would this be a sex matter; to the child it would be a mystery all by itself, unrelated to any of the other taboos in which she had been trained. So if, as the psychoanalysts claim, it is true that many adult maladjustments go back to conflicts about sex during early childhood, it is still not safe to assume that these conflicts have had any direct connection at all with sex desires or sex interests in the child himself.

The lesson that we may learn from the psychoanalysts is not the limited idea that we must always look for some underlying sex factor in connection with any unexplained fear, worry, or other symptom of maladjusted behavior in a child or an adult, but rather that we should try to ascertain what meaning the situation giving immediate rise to the behavior over which we are concerned has taken on for him. Since, as we have seen, the most vivid and persistent meanings arise in connection with situations of marked emotional content, we may expect to find that in the majority of cases the origin of the difficulty may be traced back to an emotional episode of some kind. It may be a sexual event; it may be something quite different. Moreover, we shall find that such conflicts usually have their roots in something that interferes or threatens to interfere with some strongly developed impulse or desire. This desire may be related to sex, to the craving for self-assertion, to material wants such as money or professional success, or to the desire for social companionship or for the love or friendship of some one person. And the particular symptoms that develop as a result of the conflict will depend on the meaning that the original situation had for the individual in question and the method by which he attained satisfaction at the time. If the meaning was, so to speak, "correct," that is if the nature and causes of the interference were clearly understood, the resultant behavior is likely to be simple and direct. We have plenty of examples of children

who, instead of developing strange fears and anxieties over the birth of a baby brother or sister, recognize him at once for the interloper that he is and vent their displeasure by attacking him, trying to tip him out of his cradle, or perhaps refusing to look at him and denying his existence when asked about him. Behavior of this kind is, by comparison, easy to deal with because its motive is evident. But when, either through direct conditioning, through incomplete understanding of the situation, or as a result of conflicting motives, some extrinsic and often trivial object or circumstance becomes capable of arousing an unusual form of response, the condition is harder to correct because its origin is so obscure and the resulting behavior may appear so inappropriate to the motives from which it sprang.

What Is a "Mental Conflict"?

Suppose that a child who dearly loves both his parents but who also wants to stand first in their affections is continually made jealous by the signs of their fondness for each other. He feels that he *must* do something about it. This feeling of "must," as we have seen, is an essential component of emotion. Yet what can he do? His jealousy prompts him to do injury, but his love for both parents makes this impossible. Something *must* be done. In the course of his restless groping for an outlet that will satisfy both his love and his jealousy, chance often provides a solution. Perhaps he is startled by some unexpected noise after he is put to bed. He cries out, his mother comes to him and soothes him. The original fright was slight, and ordinarily would have had no permanent effect. Note, however, that the result of the fright is something which satisfies the deeper emotion that was there all the time, the jealousy, the unsatisfied desire to be the center of affection. So, by a process closely resembling that of ordinary conditioning, the situation "being alone in bed" takes on a terrifying

meaning for him. It becomes identified with a state of jealousy culminating in terror. He cannot tell what he is afraid of, for he does not know. But his night terrors persist, sometimes for years or even into adult life.

The blocking of emotional behavior, the state of anxiety and indecision that comes when emotions leading to opposite courses of actions are simultaneously aroused, constitutes what is commonly known as a mental conflict. Because the drive to action is as strong as ever but its usual pathways are blocked off, a mental conflict often results in the setting-up of some unusual form of behavior that seems quite unreasonable to an outsider. The feelings of anxiety, uncertainty, and worry that result from the conflict become attached to some outside fact, perhaps very trivial in nature, but which thereafter takes on a meaning that is far from trivial to the person concerned. To him it has become an object of worry, of fear, anxiety, and dread. He does not know why, because the original emotion had no clear pattern. It was not a case of "I *must* get away from that bear" but rather of "I *must* do something, but I don't know what."

Unusual fears, worries, and anxieties are not the only obscure forms of behavior that mental conflicts may engender. It sometimes happens that the child who is the victim of conflicting motives discovers a method whereby his difficulties may for the time be reconciled. He loves his parents and wants their undivided attention; he would like to punish them for diverting to each other some of the love that he feels to be rightfully his. He finds that both these desires can be satisfied by some form of misbehavior. So he takes to nail-biting or perhaps to swearing or stealing. In this way he gets both revenge and a larger share of attention. Thus he finds a kind of pleasure in his misdemeanors. They have become for him a way out of his difficulties. And so the emotional drive, the feeling that "I

must do something but I don't know what" changes to "I *must* bite my nails," or steal, or swear, or whatever other act it may be that has provided satisfaction for the emotional conflict.

Mental conflicts may then lead either to a transfer of fears and anxieties aroused by the conflict to some other factor in the situation (as in ordinary conditioning) or to certain compulsive acts, things that one feels obliged to do whenever the feeling of conflict becomes acute. In either case the reason lies in the attachment of a new and ofttimes very unusual meaning to a situation or an activity. On the one hand we have, "This object or situation is something that (through conditioning) I have grown to fear"; on the other hand, "This act is something I must do to relieve my distress."

Mental conflicts, like other emotional states, vary in duration and intensity. Many are trivial and soon over; some persist for many years. But the meanings to which they give rise often far outlive the conflicts themselves. Because early childhood is of all periods in life the time when new meanings are being formed most rapidly, it is not surprising to find that a large proportion of adult worries and anxieties, particularly those which seem to others to be unwarranted, have their origin in the unremembered experiences of childhood.

The Reconditioning of Emotions

The best way to ensure healthy emotional development would be to see to it that no unfortunate experiences leading to the attachment of emotional behavior to inappropriate events should occur in the child's life. Like many other ideals, however, this is one not likely to be completely possible of fulfilment, though intelligent understanding of the mechanisms by which undesirable emotional behavior may arise sometimes makes it possible to avoid difficulties that

would otherwise ensue. But is prevention the only answer? Can't we do something for the emotional conflicts or other difficulties that already exist in ourselves and in others?

Yes. If we can find out how the difficulty started, we can attack the matter directly by pointing the way to a new and more suitable emotional outlet, if the disturbing condition still exists, either by correcting the cause of the disturbance or by explaining facts that may have been misunderstood; thus a new and more desirable meaning may be substituted for the former undesirable or inappropriate one, and so the difficulty may be overcome. In the case of the little boy who became afraid to go in swimming, once the origin of the fear was discovered its correction became an easy matter. It was explained to him that fish do not bite little boys but only fish-worms and that when little boys come into the water all the fishes swim away fast (and this was verified by taking him to a pool where there were a number of minnows and encouraging him to put his hands into the water. Further assistance was given by buying him a bowl of goldfish in order that pleasant associations with fish might take the place of the unpleasant ones. In this case the fear disappeared within a few days and never returned.

If the fear or anxiety has arisen through simple conditioning and there is no longer any active cause for it, it is often possible to correct matters by "reconditioning," even though the origin of the trouble may remain unknown. Reconditioning means that you attach a new and pleasant meaning to the fear-producing object or situation by associating it repeatedly with pleasant events. Mary Cover Jones * found, for example, that children who were much afraid of rabbits or other small animals could be trained to accept them with no signs of fear by bringing the animals gradually nearer and nearer when the child was eating food that he

* Mary Cover Jones, "A Study of the Emotions of Preschool Children," *School and Soc.*, 1925, 21: 755-758.

liked. So an initial dislike of some one who has never offended us and which was probably caused by the fact that he happened to remind us of some unpleasant experience soon disappears if later associations are pleasant.

But suppose we are dealing with a mental conflict that is still present and that, through one or another of the mechanisms we have described, is expressing itself in some undesirable or bizarre form. In such cases it is not likely to do much good to recondition the particular behavior that happens to be shown, for the underlying cause is still there and is likely to break out again in some other form. If careful study fails to reveal the true nature of the difficulty, it may be best to consult a psychiatrist whose training and experience in such matters will often enable him to unravel mental snarls that to the layman seem hopelessly puzzling.

Chapter XIV

GENERAL INTELLIGENCE AND ITS MEASUREMENT IN EARLY CHILDHOOD

How well can we judge from a child's everyday behavior whether he is bright or dull?

Why is casual observation not always a safe guide in estimating the intelligence of others?

What do we mean by an intelligent action? by an intelligent person?

What are some of the advantages of an "intelligence test" as compared to casual observation? Who devised the first useful intelligence test?

What do we mean by mental age? by intelligence quotient? by percentile rank?

Does the I.Q. always remain the same for a given individual?

From an intelligence test given to a baby of six months how well can we predict what he will be able to do at eight months? at eight years? Why does the predictive value of intelligence tests increase after children learn to talk?

What are some of the practical uses of intelligence testing in early childhood?

Are there sex differences in intelligence? What factors other than sex show a relationship to intelligence?

How do Spearman and Thorndike differ in their views of the organization of mental abilities? What general fact are both theories designed to explain?

What Is Meant by *General Intelligence?*

"My, isn't he smart!" exclaims the cordial visitor, as she watches the antics of her friend's baby. "You would think he was a year old instead of six months!"

"Helen is the brightest child I ever saw," says a teacher. "She learns a thing almost before you have told it to her and never forgets it afterward."

"I never saw anything like the way George will figure things out," says another. "He found an old alarm-clock that his father had thrown away, took it all apart and fixed it so that it runs as well as ever again."

We hear judgments such as these almost daily. Brightness, smartness, cleverness, brains—whatever this quality may be called, it is universally recognized as one of the most important attributes of any individual at any age. Probably as far back as the times of our cave-dwelling ancestors, intelligence, particularly that aspect of intelligence which we call "mental alertness," was recognized as important, and those who were most alert mentally had some advantage in the struggle for existence over those who were more dull and sluggish.

But although we may talk about it glibly enough, when it comes to stating clearly just what we mean by *intelligence* we find ourselves in some difficulty. What causes us to classify this child as bright, that one as stupid?

Before we can answer this question, we must first of all rid ourselves of the idea that intelligence is any kind of quality or substance that exists in man apart from his actions. Just as we may say that John runs fast or dances gracefully or speaks eloquently or writes fluently, so we may say that he acts intelligently or unintelligently. Too, just as we may on occasion use any of the foregoing terms to describe a single action, an individual bit of behavior, so we may also use them in a more general sense to charac-

terize the most usual or typical quality of the actions of any person. We may say, "How fast John is running." Here we refer only to the action of the moment. There is nothing in the statement that indicates John's usual speed. But if we say, "John is a swift runner" then we have reference not to a single performance but to the average of many. "Intelligence," like "speed," "grace," "eloquence," is nothing more than a term used to characterize certain qualities of human action. Like them it is manifested in varying degrees by different persons or by the same person on different occasions.

What qualities of action are included under the term "intelligence"? To answer this question we shall do best to think first of a single act. Instead of trying to say what a person must be like in order to be intelligent, we shall first ask, What is an intelligent action?

Most of us will agree that an act which is well adapted to achieving its object, a plan that works quickly and easily, should be classed as more "intelligent" than one that fails to work at all or that accomplishes its results only at the expense of much waste motion and after many false starts. Now if we go a bit further and ask what it is that makes for well-adapted action, for "intelligent" action as opposed to stupid bungling, we are likely to come to the conclusion that we act most intelligently when we respond to relationships between things, to abstract ideas and general principles, and not when we respond only to single items that are only a part of the situation. Terman, who is the author of our most widely used "intelligence test," is of the opinion that *we are able to act intelligently in proportion as we are able to think in abstract terms.*

Consider a few examples. If you put a hungry hen on one side of a fifteen-foot length of wire fence and scatter corn on the other side, the hen will dash at the fence, beat her wings against it, rush back and forth for short distances,

but it will be a long time before she finds her way around it. If you continue to do this every day, using the same fence in the same place, after a time the hen will learn to run around the fence very quickly when she sees the corn. But now if you take her to a new place and substitute a wooden picket fence for the wire fence, her previous experience will not help her much. She will go through the same old round of fluttering her wings against the fence, dashing against it, running back and forth along it until finally she happens to find her way around. Each new fence in a new place is a completely new experience to her because she is responding only to the individual items—the particular fence, the particular place. But to a human being, even to a child, the two situations would have so much in common with each other and with other previous experiences of a like nature that they would present but few difficulties. A child of three years or an ape will pile boxes one on another in order to secure an object that is beyond his reach, but a goat sees no relationship between a box that he could easily push into position and food that is too high for him to secure.

Responding to relationships, to abstract ideas rather than to single concrete facts, has another consequence which we also associate with intelligent action. This is *adaptability*. An abstraction embraces many facts to all of which the same rules will apply. The baby whose cart is caught by the rocker of a chair pulls and jerks at it and perhaps screams for help, but he does not look to see what is holding the wheel or how it may be loosened. The child of five looks for the cause of the difficulty and tries out one plan after another until he succeeds in freeing it. Each of these plans is based on some idea of relationship, not clearly thought out, perhaps, but nevertheless distinctly more than just random fumbling.

As a first step toward our definition we may then say that

intelligent action is action that is governed by broad rather then narrow meanings. It is response to relationships, to likenesses and differences, to principles rather than to isolated facts. If the principle is right, then the action will meet our first practical criterion of effectiveness. It will "work." But even when the principle selected is wrong, the action that is based upon a general idea differs from that determined by single isolated facts that have not been brought into relationship to each other. The former action is organized. Its parts follow each other in a patterned order. The latter has no very clear-cut pattern or at most its pattern consists of the repetition of a single act that may or may not be appropriate to the situation.

A child is playing on the floor with his blocks. At first he piles the blocks aimlessly, putting two or three together, then knocking them down, stopping now and then to hammer one against another or to toss them about the room. Suddenly he stops, pushes all the blocks to one side so as to leave a clear space, then selects certain ones and begins to arrange them in a definite order. You say, "He has an idea." You do not see the idea. You may not even be able to guess what it is. But the change in his behavior is so marked that you cannot help but notice it. Now his plan may not work. Judged from an adult standpoint it may even seem foolish, unintelligent. But here is the important thing. By making a plan, even a bad plan, and actually putting it to the test he has given himself a kind of experience that is highly charged with meaning. And the next time he tries he will be far more likely to devise a plan that does work than he would be if he had spent the same amount of time in the random activity with which he began.

We often hear it said that the intelligent person is the one who profits most by his experience. It would be more correct to say that the experiences of the intelligent person are more likely to be of a kind that facilitate learning.

Experiences with carrying out a plan, with testing an idea, with seeing a relationship carry more meaning and so leave a more lasting impression than experiences that deal only with isolated concrete facts.

In summary, then, it may be said that intelligent action is planned action, action that is determined by the organization of many simple meanings into a complex and relatively complete whole. A practical test of intelligent action is the extent to which it "works," how effectively it achieves the desired result. For we all know that when our plans fail to work it is usually because they are incomplete, because we have failed to take account of something that has an important bearing on the result. Now the only practicable way of handling many facts at once is to pack them up into a series of mental bundles, being careful to put into the same bundle only those things that have a like relationship to our problem. Instead of having to handle each little fact separately, we can then deal with a multitude of facts at once because we can think in terms of the various bundles, that is in terms of rules, relationships, principles, instead of the isolated concrete facts on which they are based. And still greater efficiency is gained when we cease to work even with these more conveniently handled bundles of facts, and substitute for each a symbol that is to the bundle what a luggage check is to the heavy and clumsy trunk that it represents. The modern engineer would be hard put to it if he had to plan his bridges, his tunnels, his skyscrapers in terms only of such miscellaneous unmeasured blocks of stone as might be available, hunks of metal, spadefuls of cement, as does the African native in building his hut of mud and reeds. Even weights and measures, strains and stresses, velocities, and forces are clumsy material for thought in comparison with the compact mathematical signs that stand for them. Mental activity is classed as intelligent activity in proportion as it substitutes broad abstract mean-

ings that can be efficiently manipulated in many situations for the narrow concrete meanings that are applicable to but few situations. But to meet our additional criterion that intelligent action is action that "works," that brings results, these abstractions must be built up on a sound basis of facts as they exist in nature. The visionary whose head is always in the clouds is not necessarily a man of high intelligence. Abstraction is not an end in itself. It is a tool which, if properly forged and efficiently manipulated, enormously extends man's control over his concrete environment.

Judging Intelligence from Behavior

Observation of the everyday behavior of children or older people gives us some basis for judging how intelligently they usually act. This one shows planfulness, resourcefulness, judgment. He can do many things. He has a large fund of information on many subjects. He talks well, and this is a fact that it is important to note, for words are symbols and facility in their use is good evidence of the ability to think in abstract terms. Another has a small vocabulary which he uses inexactly; he is inept, attacks problems in a random, fumbling manner, and rarely succeeds in solving them. Even the most casual observation leaves little doubt that a real difference in ability is to be seen here. But how great is this difference? Observation alone does not tell us.

Observation, moreover, is not always a safe guide. Everyday behavior tells us something, but chance circumstances rarely provide the best possible conditions for judging ability of any kind. Not all of a child's conduct provides a fair picture of his intelligence any more than his everyday play always gives evidence of his physical strength. The child who is sitting quietly on the floor looking at a picture-book is not using enough of his physical strength and energy at the moment to give us much idea of what he could do in a pinch; nor is the one who is sitting at the window aim-

lessly looking out into the street using enough of his mental ability, just then, to provide much basis for judging his real intelligence. Of course if we watch children or older persons for a long period of time, enough situations will naturally arise that challenge either their physical strength or their mental powers to tell us something about their ability along those lines. But these situations vary so greatly from one person to another that even long acquaintance will not provide more than a rough basis for judgment.

If you take a group of children of the same age and ask two persons, both of whom have known them intimately, to arrange them in order of intelligence, complete agreement between the judges will rarely be found. Here, for example, is the way two nursery-school teachers working with the same group of fifteen children estimated their relative intellectual abilities. All the children were between the ages of three and four years.

Teacher A	*Teacher B*
1. Polly	1. Polly
2. James	2. Peter
3. William	3. Mary
4. Mary	4. Emily
5. Harry	5. James
6. Stanley	6. Catherine
7. Peter	7. William
8. Thomas	8. Harry
9. Betty	9. Frank
10. Frank	10. Stanley
11. Emily	11. Thomas
12. Joan	12. Joan
13. Catherine	13. Betty
14. George	14. Sidney
15. Sidney	15. George

Both teachers agree in placing Polly at the head of the list and in regarding George and Sidney as the most backward. But Peter, whom Teacher B ranks next to the top,

is placed near the middle of the group by Teacher A. William, Emily, and Catherine are also judged very differently. Of the fifteen children, only Polly and Joan are given exactly the same rank by both teachers. Yet there is some tendency to agreement. Children placed near the top of one list are not found at the bottom of the other, though they may have moved downward a few places. The agreement is better than chance, though it is by no means perfect.

People disagree when they attempt to rate the intelligence of others on the basis of casual observation, not only because so many of the situations they have observed offer no effective challenge to ability but also because, often without being aware of it, they are influenced in their judgments by many things that are not intelligence at all. Rare indeed is the person who can successfully disentangle a child's everyday manifestations of intelligence from his dirt, dimples, curls, and cuddliness. Mary is regarded as bright because she has big dark eyes and pretty manners; Tommy is looked upon as stupid because he is physically clumsy and is subject to colds in the head that force him to breathe through his mouth. Peter is so large for his age that every one judges him by the standards of children two years older than he is. Because he does not always meet these standards, he is thought to be mentally backward. Really he is of average mental ability for his age, though not for his size. Doris is so shy that few people ever get a glimpse of her real ability, while Edward displays himself and his ideas without stint before any one who will pay him a moment's attention.

Early Attempts at "Measuring" Intelligence

Early in the present century Alfred Binet, a French psychologist who for many years had been studying differences in ability as shown by school-children, was entrusted by the school authorities of Paris with a difficult and important

task. "How," said the school people, "are we to know what causes children to fail in school? Some children fail because they are lazy and mischievous. Others fail because they cannot learn as easily as the average even when they try. Is there no way of telling which children cannot profit by the ordinary kind of teaching so that we can pick them out and put them in special schools where they will no longer hamper the progress of the others but can be given work that they can learn to do?"

Binet undertook to answer this question. First he tried to see how well teachers could judge the ability of children. He found, just as we saw in the last section, that there was a good deal of disagreement among them even when the children were well known to them. When he asked the teachers what they took into account in making their judgments they gave various answers. Some relied mainly on the child's appearance—the shape of his head, the "glance of the eye." Others mentioned such things as his powers of observation, his memory for things seen and heard, his range of information. But none of them had more than a vague and general idea about what store of information it is fair to expect of a child at any age, how good should be his memory or what his ability to observe.

This was in 1904-1905. The idea of devising tests of mental ability was not a new one at that time: for more than a decade psychologists in England and America had been experimenting with simple tasks that they called "mental tests." But to Binet belongs the credit of first devising tests that really worked, that did to a fair extent serve to differentiate the dull from the bright. Binet succeeded where others failed because of two important differences between his method and those of his predecessors. Earlier workers had thought it not feasible to try to test anything but the "simpler" abilities. They had hoped to find out how fast a person could think by seeing how rapidly he could move his

fingers in a tapping test; how soundly he could reason and draw conclusions by finding out how well he could judge the length of lines or distinguish small differences in weight. Furthermore, they had hoped that a person's "general" ability could be determined by means of only a small variety of tests. Binet's plan was very different. In his tests he emphasized difficulty rather than speed, complexity of performance rather than simplicity. He aimed to set for his subjects tasks that would really serve as a challenge to their mental powers. So he tried to test their ability to solve difficult and complex problems by setting them problems of increasingly greater complexity until a level of difficulty was reached at which they could no longer succeed. Binet, moreover, did not confine himself to a few kinds of test. Children, in his opinion, differ so greatly in special aptitudes, in individual experiences, and in home training that to rely exclusively upon a small number of measures is likely to mean that some children who have had unusual advantages along those particular lines will be unduly favored while others with a different background of experience will be handicapped. His selection was therefore made with the idea of including as great a variety of performances as possible. Although to an inexperienced person his tests seem rather like a hotchpotch, actually no test was included in the series that had not been shown by actual trial to differentiate between children whom their teachers thought to be dull and those who were adjudged bright.

Binet's first series, known as the "1905 scale," included thirty tests arranged in order of difficulty. In giving it, the easier tests were first tried, then the harder ones, until it became evident that the child could go no further. The number of tests he could pass was then taken as an index of his level of ability. The method was crude, but it worked better than any that had been tried before.

Still Binet was not satisfied. He had devised a method of

testing, to be sure, but there was no very meaningful way of expressing the results. He could say that Mary had passed seventeen of his tests while Johnny could only pass twelve, but what of it? Did that mean that both were backward, but Johnny more so than Mary; or that both were bright, but Mary was the brighter? And what about ages? If Mary were older than Johnny, we should expect her to do better. Perhaps in proportion to age the two were equally bright.

Then Binet had a happy thought. Since ability increases with age throughout the period of childhood, why not make use of this fact in interpreting test performance? Why not find out just what children of different ages can do on tests of this kind and make up a series of tests for each age? Then when other children are to be tested, we can first try them with the tests at their own age level. If they cannot do these, the tests for the age next lower can be tried and so on until a level is reached at which the child can just barely succeed. In this way his performance takes on a more definite meaning, for if he is ten years old and yet can only do the tests that the average five-year-old can pass, we have gained a much clearer picture of his ability than is given by finding out that he can only pass nine out of a series of thirty tests. It is like saying that at ten years a child is so small that he only takes a five-year size in suits. We not only know that he is retarded in growth, but we have a fair idea of the amount of his retardation.

In 1908, Binet published his first "year-scale" in which the tests were arranged in groups according to the age at which they could ordinarily be passed. There were four or five tests for each age. Scores earned on this scale were no longer to be expressed simply in terms of the number of test items passed but as "mental ages," a new expression destined to become very popular. A child who can pass the six-year-old tests but not those designed for seven-year-olds is said to have a mental age of six, no matter what his actual

chronological age may be. If he is only four but can nevertheless pass the six-year-old tests, then he is much brighter than the average. If he is nine years old but has still not advanced beyond the six-year test level, he is backward; perhaps he should be classed as feeble-minded.

Binet died in 1911, just after revising his scale of tests a second time. But although his methods were then far from having been perfected, their possibilities had been glimpsed by many persons. In America both the 1908 scale and the 1911 revision had been translated into English by Goddard and were already gaining extensive use. Later on Terman, Kuhlmann, and others worked out further modifications in the scale as it was left by Binet and succeeded in correcting a number of its weak points. They also extended it at each end. As left by Binet, the scale included tests for the ages from three to thirteen years. Terman extended it upward to the adult level; Kuhlmann added tests for very young children and infants down to the age of three months.

Samples of Kuhlmann's tests for the early ages follow:

Three months. Carrying hand or object to mouth.
Six months. Turning head toward source of a sound.
Twelve months. Imitation of simple movements.
Eighteen months. Feeding self with spoon or fork.
Two years. Pointing out objects in pictures.
Three years. Naming familiar objects.
Four years. Stating his own sex.

A further step of great importance in interpreting the results of tests was taken when, in 1912, William Stern of the University of Hamburg proposed the use of the intelligence quotient, now generally known as the IQ to show the relationship between a child's mental age and his chronological age. It obviously is much more significant for a child of four years to be mentally two years in advance of his age than it is for a child of twelve to be accelerated two

years, for the former has had only four years in which to gain his advanced standing while the latter has taken twelve years to do so. The intelligence quotient, which is obtained by dividing the child's mental age by his chronological age, is designed to reduce the amount of acceleration or retardation to a uniform standard for all ages by expressing the one as a percentage of the other. A child of six with a mental age of eight would thus be said to have an IQ of 8/6 or 133. One whose chronological age is six and whose mental age is only four would have an IQ of 4/6 or 67.* The IQ was first made popular by Terman and is now the most widely used method of expressing the results of intelligence tests among children.

Modern Intelligence Tests for Young Children

Up to a few years ago, the various revisions of the Binet scale were almost the only kinds of tests suitable for studying mental differences in young children. Although these tests were decidedly better than none at all, they were nevertheless less useful for children of preschool age than for school-children. As a matter of fact, in devising tests for the ages under five, backward children of school age had been kept in mind far more than the younger normal children who, before the days of nursery schools, were not often tested. The Kuhlmann 1922 revision of the Binet scale includes tests for the ages under three years and for infants, but these tests were standardized on fewer cases than were his tests for children of school age and the items are probably not so well chosen.

More recently several new tests for preschool children have appeared. Two of these tests will be described rather briefly in order to give a more concrete idea of the kind of tasks that have been found useful indicators of general mental level in young children.

* In writing the IQ it is customary to omit the decimal point.

FIGURE 48

THE SEGUIN FORM BOARD TEST

This is one of the tests in the Merrill-Palmer series; it has also been used in a number of other tests of the non-verbal sort. It is scored in terms of the length of time required to put all the blocks into their proper recesses in the board and the number of errors made in doing so.

(Photography by courtesy of the University of Minnesota Institute of Child Welfare.)

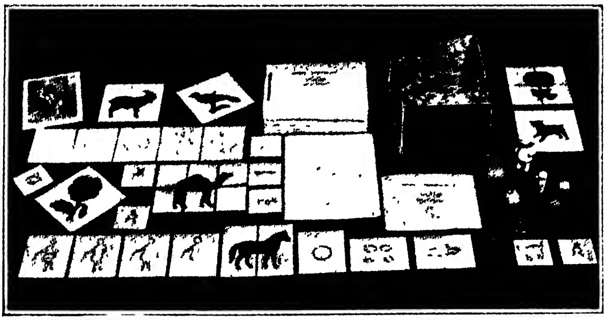


FIGURE 49

SOME OF THE MATERIALS USED IN THE MINNESOTA PRESCHOOL TESTS

(Courtesy of the Educational Test Bureau, Minneapolis.)

The Merrill-Palmer Tests,* devised by Rachel Stutsman and her assistants at the Merrill-Palmer nursery school in Detroit, are intended for use with children between the ages of eighteen months and five years. They make only a small demand upon language, since they include chiefly tests of fitting blocks of different geometrical forms into their corresponding recesses in a board known as a "form-board," tests of ability to button and unbutton, tests of the ability to put cut-up pictures together, to copy simple designs, and so on. Figure 48 shows a child of four years working at a form-board.

The Minnesota Preschool Tests † are divided into a verbal scale, a non-verbal scale, and a combined scale which makes use of both verbal and non-verbal responses. The materials for these tests are shown in Figure 49.

In addition to mental ages and IQ's, both these tests provide for the interpretation of scores in terms of *percentiles*. A "percentile score" or "percentile rank" shows where the child would stand among a representative group of 100 other children of his own age if all were arranged in order from dullest to brightest. A percentile rank of 50 means that he would rank in the middle of the group, that is, just average in ability for his age. A percentile rank of 75 means that he would stand midway in the upper half, or in other words that for every child who is brighter than he there are three who are less bright. A percentile rank of 10 places him tenth from the bottom, with 90 per cent of the children of his age brighter than he is.

The percentile method of interpreting scores has certain advantages over the mental age and intelligence quotient. Chief among these, especially for young children, is the fact that comparisons are made between children of the same

* Rachel Stutsman, *Mental Measurement of Preschool Children* (Yonkers-on-Hudson: World Book Company, 1931).

† Published by the Educational Test Bureau, Minneapolis.

age, not between those of different ages. A backward child of ten may have the same mental age, that is, he may pass the same tests as a bright child of five. But he is nevertheless not like the child of five, even intellectually. Much less is he like him in his social and emotional characteristics. The mental age concept is useful because it gives us an inkling of the level of development to which a child's ability most nearly corresponds, but we must not take the picture too literally. The bright child differs from the backward child of the same mental age in the *quality* of his intelligence. He is more alert, he has greater zest in doing and in learning new things. The backward child is inclined to wait for experiences to come to him; he is the tool of circumstance. The bright child does not wait for events. He goes in search of them. He creates them and bends them to his will. So as age advances the bright child continues his rapid mental growth, while the dull child also gains but at such a slow pace that the mental distance between the two steadily increases.

The Predictive Value of Tests Given in Early Childhood; the "Constancy of the IQ"

Many investigators have shown that the IQ's of schoolchildren show surprisingly little change from year to year when repeated tests are given. A child who starts out with a 25 per cent advantage over the average for his age, that is with an IQ of 125, maintains about the same ratio between his mental and his chronological age from year to year thereafter. There may be slight shifts, as one might expect, for no method of testing is perfect and no person is always able to work at his highest level. Every one has his ups and downs and we should expect mental test scores to fluctuate slightly with changes in mood, in interest, in effort. The surprising thing is that they remain as constant as they do. Occasionally, it is true, large shifts—sometimes of as much

as twenty-five or thirty points—occur in individual cases, but this does not happen very often. After the age of six years, retests, even when given at long intervals, usually show variations from the original IQ not greater than five or six points. In spite of occasional exceptions, in general it may be said that the bright remain bright, the dull remain dull, the mediocre continue to be mediocre.

Because of this marked tendency of the IQ to remain constant,* or more exactly speaking to vary only slightly from time to time, the tests have been found to be useful in giving a more exact indication than was formerly possible not only of what a child can do now but also of the amount of mental progress he is likely to make in the future. Of course caution is necessary in making any final prediction; yet the practical fact remains that planning for the future is necessary. In making such plans repeated investigation has shown that the IQ is not only a better indicator of present mental capacity than personal judgment is likely to be but that it also makes possible the forecasting of later mental status with a smaller margin of error than would otherwise be the case. No intelligence test is infallible, but when such tests are properly given and interpreted considerable confidence in the results seems to be warranted.

So much for tests of school-children. But what about the younger ages with which we are at present concerned? How far are we safe in assuming that an IQ of, say, 130 (which indicates decided advancement) obtained at the age of three will not later fall to 100 (average for age) or even lower? Can we be reasonably sure that the two-year-old whose test score gives him an IQ of 75—a rating which, if taken literally and interpreted as it would be at a later age, would

* Assuming always that the tests have been given by a competent examiner under fair conditions. The giving of mental tests is a highly skilled performance, requiring special training and a good deal of experience.

classify him as very backward indeed—will never rank up to par mentally?

It has been assumed by many people that, just because the IQ has been found to remain so nearly constant at the later ages, equal confidence in its predictive value is warranted when the tests are given very early in life. But more recent study has shown that such is not entirely the case. Shifts in rating from one test to another are decidedly more frequent and of larger amount among children of preschool age than among older children. Whereas among schoolchildren changes in IQ from test to retest, even after an interval of several years, will in most cases not exceed five or six points in either direction, changes of eight and ten points are fairly common before the age of five, and much larger changes sometimes occur.

We cannot be sure just what these changes signify, although it is practically certain that, in many cases at least, they do not indicate changes in real intelligence at all but are merely the result of differences in interest and effort. Yet we cannot be certain that the mental growth curves of individual children follow a straight and uniform pattern from one year to another without ups and downs. Whether these changes are due to differences in training, to more stimulating environment, or to better health and like factors that are to some extent within our control, whether, in other words, it is possible to bring about a genuine improvement in the mental level of young children through providing better care and training in early life, is still a matter of controversy. Until more and sounder evidence is forthcoming, it is better to avoid dogmatic statements about what can or cannot be done in the way of raising the mental level of children and to provide for each as wholesome an environment as possible. Of one thing we may be quite sure. Not only do children differ in their actual levels of mental ability, but they also differ greatly in the efficiency with which

they use the talents they possess. We may or may not be able to improve their IQ's, but we can at least see to it that whatever ability they possess is given adequate opportunity for expression.

Thus far we have said little about the tests that have been devised for studying mental development in infancy. Several tests have been worked out, but their significance is still very questionable. One valuable service these tests have certainly performed. They have provided us with far more exact data than we should otherwise have had on the usual course of mental development during the first eighteen months of life. But their meaning for the individual baby is less clear. Probably a baby who ranks high on these tests may fairly be said to be more advanced at the time of the test than the average child of his age. But will he remain so?

Gesell, who more than any other single person has contributed to our knowledge of the usual course of infant development, thinks that he will. But others who have taken the Gesell standards and put them into more conventional test form have not always found this to be the case. For example, Linfert and Hierholzer * devised a series of tests for infants in which the greater number of the items were taken over from Gesell's schedules. They gave these tests to 300 babies ranging in age from one to twelve months. At every age, much difference in test standing was shown by the individual babies. Their "IQ's" differed about as much from each other as do those of older children. And the test results were internally consistent. Babies did not fail on easy tests and then unaccountably pass harder ones; some were consistently advanced along all lines, while others were equally consistent in their backwardness. All this looked very promising.

* H. E. Linfert and H. M. Hierholzer, "A Scale for Measuring the Mental Development of Infants During the First Year of Life," *Catholic University of America: Studies in Psychology and Psychiatry,* 1928, No. 4. Pp. 33.

Four years later, Furfey,* under whose direction the original study had been made, thought it would be worth while to find out whether or not bright babies develop into bright little boys and girls. So he set to work and hunted up as many of the original group as he could find—he was fortunate enough to locate nearly half of them—and retested them, using the Stanford Revision of the Binet tests about which we shall have more to say in a later chapter.

Did the IQ's earned in babyhood remain constant? Hardly at all. Some of the bright babies now seemed rather backward, some of the apparently backward ones had become bright. Others kept their original places, but this was true in only about as many cases as one would expect by chance. Indeed if one had written the various IQ's on slips of paper and had each child draw his own from a hat with his eyes closed, about as much relationship as was found between the two series of tests might have been expected. Nancy Bayley,† working with a group of about sixty infants over a period of years, found much the same thing to be true. The amount of agreement between successive tests became steadily less as the interval between testings increased or as the age of the children at the time of the first test decreased. For example, there was a fairly good agreement between tests given at nine and again at twelve months but only slight agreement between tests given at three months and again at twelve months, while a year or two later even this small agreement had disappeared.

All this need not be taken to mean that there are no signs by which later mental development may be foretold during the first year of life, but it does mean that if such signs exist we have not yet learned to read them with accuracy.

* P. H. Furfey and Josephine Muehlenbein, "The Validity of Infant Intelligence Tests," *J. Genet. Psychol.*, 1932, 40: 219-223.

† Paper read at the 1930 meeting of the American Psychological Association.

Some day we may succeed in finding what they are, but we must be careful not to confuse such a possibility with present accomplishment.

After children learn to talk, mental tests begin to take on greater significance for the future. Returning to the questions asked on page 309, we may say with assurance that while the child who at the age of three is found to have an IQ of 130 *may* later on drop to 100 or even somewhat lower, the chances are decidedly against it. On the other hand, it is not at all improbable that on later tests he may go as high as 140 or as low as 120. Changes as great as this occur fairly often among children of this age. Upon the whole we are not likely to go wrong in predicting that such a child will always be brighter than the average, but just how much brighter is a question about which we can be less certain. Likewise, the child who is found to have an IQ of 75 at the age of two years is not likely (assuming, of course, that his low rating is not due to shyness or lack of coöperation) ever to reach the average level. He may, however, approach it more nearly than he did at the age of two, or on the other hand he may fall still further behind.

Practical Applications of Intelligence Testing in Early Childhood

People sometimes say, "But after all, why do we need to worry about the intelligence of children before they are old enough to go to school? Provided they are not feebleminded, what real difference does it make whether they are bright or stupid? And in any case, why do we need to know any more about their ability than we can find out by watching them?"

Long before they enter school, children form habits and attitudes that affect their later progress in many ways. Important among these are attitudes toward success and failure. The child from whom more is expected than he is

able to give is likely to develop a feeling of inadequacy and insecurity that he carries with him into the school-room, making it unlikely that he will accomplish as much there as he could if he were unhampered by expectation of failure. On the other hand, the exceptionally bright child whose ability has gone unrecognized may become an active problem to parents and teachers because his alert mind is not given enough useful employment, and he is thus forced to seek it for himself. In the search he gets continually into mischief.

Even more important problems arise in individual cases. Here is a child to be placed for adoption. What kind of home should we try to find for him? "The best possible," the humanitarian will say. Agreed, but is the home of superior culture where college training and a subsequent career in one of the learned professions is assumed as a matter of course the "best possible" home for Jimmy if his final scholastic ability is not going to be equal to taking him beyond the eighth grade? Or will he be happier and stand a better chance for good emotional and social adjustment if placed in a simpler environment with foster-parents who will look upon him with pride and satisfaction if he turns out to be a good carpenter and a good citizen? It is true that wrong diagnoses of ultimate capacity are sometimes made by the use of intelligence tests, particularly with very young children. But unaided human judgment is even more prone to error. Since we cannot put children into cold storage and leave them there until we have worked out infallible methods of dealing with them but must instead make decisions of both major and minor importance for their future welfare as the occasions arise, we shall do well to make use of all the evidence we can secure that will help us in making such decisions as wisely as possible. In spite of their imperfections, intelligence tests for children who are old enough to talk are nevertheless sufficiently accurate to

aid materially in forecasting what a child's future development is likely to be.

Factors Related to Mental Development in Childhood

In the last chapter the close agreement between language development and general intellectual development was mentioned. We now see why this should be so, for words are symbols, and the ability to use symbols in place of the more concrete facts for which they stand is one of the best evidences we have of the ability to think in abstract terms.

Differences in intelligence, like differences in language development, are associated with differences in socio-economic status. Figure 50 shows the relationship between intelligence test scores and occupation for several groups of subjects.

The light solid line shows the differences in the intellectual *requirements* of the various occupations as rated by a large group of judges. The broken line shows the differences in the intelligence test scores of American soldiers in the World War, classified accoıding to their occupations in civil life. The heavy solid line shows the mean scores on another intelligence test earned by elementary school children in New York State, classified according to the occupations of their fathers. The dash line and the dotted line show the scores earned by preschool children two to four years of age on two successive administrations of the Kuhlmann Revision (see p. 305) of the Binet tests given six weeks apart.*

As we pass from the higher to the lower occupational

* Because the groups differed so greatly in age, different tests were of necessity used. All the scores are therefore reduced to similar units, known as "standard scores," which makes it possible to compare them directly with each other. In this system of scoring the unit of measurement is known as the "standard deviation" or "sigma" (σ). The zero point is set at the average score for the group. Scores higher than the average are given a + sign, those lower than the average a — sign. In a normal distribution about 68 per cent of all cases will earn "standard scores" that fall between the limits of one standard deviation above or below the average of the group.

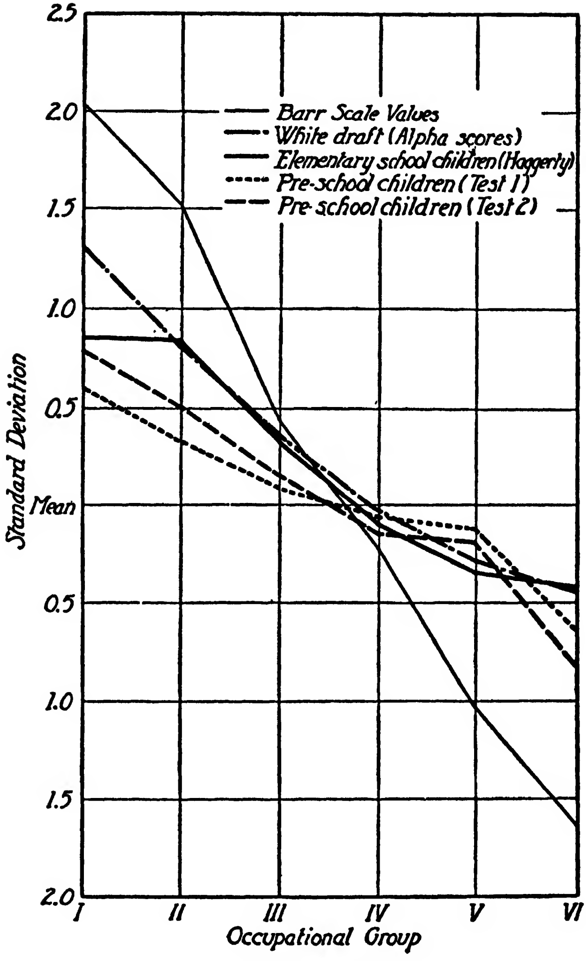


FIGURE 50

RELATIONSHIP BETWEEN INTELLIGENCE OF CHILDREN AND THE OCCUPATIONAL LEVEL OF THEIR FATHERS

(From F. L. Goodenough, "The Relation of the Intelligence of Pre-school Children to the Occupation of Their Fathers," *Amer. J. Psychol.*, 1928, 40: 284-294. Courtesy of Dr. Madison Bentley, Editor.)

groups,* the scores become progressively lower. We might expect this to be true for the soldiers, for if different occupations make differing demands upon intelligence it is natural enough for men to find their way into occupations in which they can win success. To a lesser extent we might expect the same thing to show up among the school-children whose fathers belong to different occupational classes, for those from the upper groups would on the average receive much more intellectual stimulation at home than would those from the lower groups. But it is more surprising to find that among the little children not yet in school who are tested on their ability to perform such simple tasks as pointing to the eyes, nose, and mouth, copying a circle or a square, counting four pennies, pointing out objects in pictures, obeying simple commands—tasks for which even homes of little culture provide, it would seem, ample training—intellectual differences between social classes are quite as pronounced as they are among the older children. This looks as if some factor in addition to environment were at work. Differences in heredity may be responsible, either wholly or in part. If the more intelligent fathers have been able to hold their own in the professional and managerial classes while the less intelligent have found their way into factory work, truck-driving, or pick-and-shovel jobs, it is entirely possible that the differences in intelligence shown by their children are due to differences in native endowment rather than to differences in training. Probably both factors are involved.

Do boys and girls do equally well on intelligence tests? Since girls are on the average a little more advanced than boys in language development, one might expect them to stand higher on intelligence tests as well, since these scores are so closely related to language. Actually we find this to

* Occupations are classified according to the plan described on p. 254.

be the case, particularly among young children, when tests of the Binet type or others that make considerable demand upon language are used. But the differences are very small. When tests that are based chiefly upon certain perceptual and motor skills are employed, the difference is likely to be in favor of the boys, but here too the advantage is usually very small. Apparently there are slight differences in the *patterns* of intellectual activity most often shown by children of different sex. These differences appear very early in life. But when it comes to saying which sex is the more *intelligent* in any final or absolute sense, we are dealing with a very different question and one for which science as yet has given us no clear answer. However, we need have no hesitation in saying that, if any differences exist, they are so small that no practical account need be taken of them. Indeed it is probable that even the small sex differences shown by certain tests in regard to pattern of abilities are quite as much the result of differences in interests, in play experiences and the like that are initiated and fostered by the particular kinds of toys deemed suitable for little boys and little girls,* as upon any more fundamental differences relating to sex.

Whether or not there are any bodily characteristics by which mental differences may be recognized is a question that has been hotly debated for decades. Many people think that the shape of the head, the features, the facial expression provide a sound basis for distinguishing the bright from the stupid. But when people have actually been set the task of making these distinctions among children who are unknown to them, so that they have nothing but physical traits to go by, they do not as a rule have much success. Except in the case of certain types of mental deficiency

* Magda Skalet, in an M.A. thesis written at the University of Minnesota showed that boys and girls are provided with very different assortments of toys even in babyhood.

FIGURE 51

JUDGING INTELLIGENCE FROM PHOTOGRAPHS

Look over the photographs of these six children and decide which you think is the brightest. Write the corresponding letter on a sheet of paper. Then examine the remaining photographs and decide which child you think is next in order of intelligence. Continue until all have been ranked. Then turn to the list of IQs at the end of the chapter and see how closely your ranking agrees with the test results.

(Courtesy of The Century Co.)

which can be recognized by physical signs, neither the features, the shape of the head, nor the bodily form tell us much about the mental capacities either of children or of older persons. Not even the "bumps" or protrusions of the skull beloved of the phrenologists can give us any useful information about the mental traits of their possessor. Indeed it would be very surprising if they did, for as we saw in Chapter IV (p. 70), mental traits are not correlated with the development of particular small areas in the brain. In most forms of mental activity the entire cortex is likely to be involved. Moreover, such tendencies to localization of function as exist do not follow the plan of the phrenologists' "skull-maps" at all. And finally, the contour of the skull gives but slight indication of the contour of the brain within it. Unless the size or shape of the head falls completely without the limits of normal variability—and these limits are larger than most people think—we shall not find these characteristics of much help in diagnosing mental traits.

What about bodily size and form? Are tall children likely to be brighter than short ones? Is there any relationship between intelligence and weight?

Apparently there is, at least during childhood. But the relationship is very small both as regards height and weight, and there are so many individual cases that do not obey the rule that measurements of height and weight are of little help in diagnosing mental ability. If used, they would lead us astray almost (though not quite) as often as they would help us to a correct decision. Moreover, most people who have investigated this relationship have not been as careful as they should be to take account of the socioeconomic status of the children whom they studied. If differences in mental ability are at least in part the result of heredity, as it now seems almost certain that they are, and if the more intelligent parents not only pass on their su-

perior mental traits to their children but also give them better than average physical care * and so make it less likely that they will fall below the physical standards set for their age, this alone may account for all the relationship between physical and mental growth that has been observed.†

Much the same thing appears to be true of most of the specific physical conditions related to health. Children of low intelligence more often than those of high intelligence are found to be suffering from diseased tonsils and adenoids, decayed teeth, rickets, and so on, but this may be only because stupid parents are more likely to have stupid children and also to give them poor physical care. The relationship of intelligence and health is a matter that opens up a number of interesting and important scientific problems, but practically speaking the question is of less significance. Good health is important enough to be sought for its own sake, no matter what relationship it may bear to the IQ.

Whether or not there are racial or national differences in intelligence is another question that has stimulated a number of investigations during recent years. For the most part, however, these investigations have dealt only with children of school age or with adults. The work of McGraw ‡ appears to show that Negro infants are more backward than whites in developing the forms of behavior included under one of the modern series of "baby tests," but although this is in accordance with what has been found for older

* Although superior nutritional care will probably not increase a child's height over that which is potentially given by heredity, poor nutrition and lack of physical care may prevent him from growing as tall as he might if the conditions were favorable. Weight is even more closely associated with the kind of physical care given.

† For an unusually thoroughgoing discussion of experiments on the relationship between physical and mental traits, see *Physique and Intellect* by Donald G. Paterson (New York: The Century Co., 1930).

‡ Myrtle McGraw, "A Comparative Study of a Group of Southern White and Negro Infants," *Genet. Psychol. Monog.*, 1931, 10: 1-105.

children, further investigation is needed before we can be entirely sure of its meaning.

The Relationship of Intelligence to Other Traits

It is characteristic of human nature to hope that our inferiorities in one line may be counterbalanced by superiorities in other lines. Dozens of popular phrases attest to this: "clever but dishonest," "slow but accurate"; "brilliant but emotionally unbalanced." In individual cases these combinations may be found, as we all know. But are they the rule or the exception? Is correlation or compensation more often found when the various characteristics of the same individual are compared with each other?

The fact is that it is very hard to find any two desirable traits that are not a little more likely to occur together than to run contrary to each other. Not all clever men are honest. Not all rapid workers excel in accuracy. Not all brilliant people are emotionally stable. But on the average, honesty and cleverness, speed and accuracy, intelligence and emotional stability are more likely to be found in combination with each other than with the opposites of these traits. This is true at all ages. Some traits are very closely bound together so that only occasionally will exceptions be found to the rule that a person who stands high in one will also be above average in the other. Some are more loosely connected, so that individual cases frequently break away from the rule. Sometimes the association is so slight that conformity with the rule is just barely more common than are exceptions to it and the rule itself can be discovered only by careful and unprejudiced examination of the facts for large numbers of cases.

This tendency for general superiority or inferiority to show itself in many if not most kinds of mental activity and conduct has been of great interest to psychologists interested in questions of the organization of our mental traits.

Two theories in particular have attracted widespread attention. Briefly, these theories raise the question, Have we intelligence or intelligences? Spearman, one of the greatest of British psychologists, favors the idea of a single factor that is shown in greater or less degree in all mental activity. This factor he calls *g*. He believes that because all behavior involves some amount of *g* (that is, of intelligence) the general quality of an individual's performance along any line will tend to be high or low, depending upon the amount of *g* he possesses. According to Spearman, the reason that people who are more than usually able along one line are likely, on the average, to show better than average ability along other lines is because these people have more than the usual amount of *g*. Conversely, the reason that inferiority in one line is likely to be associated with inferiority along other lines is to be found in a deficiency of *g*. Some kinds of performance make a strong demand upon *g*. These performances are closely associated with each other, since the person who ranks high in *g* will of necessity rank high in all of them, while the person who is low in *g* will do poorly in all lines that are chiefly dependent upon *g*. But in addition to this general factor, *g*, which enters to a greater or lesser extent into all performances, mental activities derive their special characteristics from various kinds of special abilities or traits known as *s* factors. A given *s* factor may be common to few or to many acts, but it always falls short of the complete generality ascribed to *g*. Activities that are chiefly dependent upon differing *s* factors and only slightly dependent upon *g* will have little relationship to each other. On the whole they will tend to be slightly associated, but many individual cases will be found in which superiority along one line will be accompanied by inferiority along the other and vice versa.

Thorndike, an American psychologist of equal eminence, holds a different opinion. In place of postulating a single

general factor running through all mental activity he regards different kinds of mental activity as highly specific in themselves though having certain elements in common. These common elements are responsible for the correspondence usually found between the levels of ability along different lines shown by the same person. But the common elements do not, according to Thorndike, make up the whole of intelligence, nor is all intelligence of the same kind. Thorndike holds that there are many kinds of intelligence that can be classified, if it seems worth while to do so, into certain broad general groups of which the following three are outstanding: (1) abstract intelligence or the ability to deal effectively with ideas and symbols, (2) social intelligence or the ability to get on with people, and (3) mechanical intelligence or the ability to handle concrete things and situations. Specific abilities falling within the same general class, such as the ability to give word opposites and the ability to supply the missing word in an incomplete sentence have many elements in common and so a person who stands high in one usually stands high in the others as well. But abilities belonging to different classes have fewer elements that are common to both, and hence disagreements in standing are more frequent.

Both Spearman and Thorndike have resorted to elaborate mathematical demonstrations to support their claims, and each has his own group of adherents. No matter which idea is eventually shown to be right, the fundamental fact which each theory seeks to explain remains the same. *Correlation rather than compensation is the rule throughout all forms of mental ability.*

INTELLIGENCE QUOTIENTS OF THE FOUR-YEAR-OLD CHILDREN SHOWN IN FIGURE 51

A	*B*	*C*	*D*	*E*	*F*
118	92	137	105	80	127

Chapter XV

THE KINDERGARTEN AGE

In what respects is the kindergarten period a time of transition for the average child? Can you cite any examples from your own experience of the changes in interests and attitudes that are likely to occur when a child enters kindergarten?

Why does the kindergarten teacher usually take a different attitude toward the child's interests and behavior from that shown by his parents?

How do the motor accomplishments of kindergarten children differ from those of younger children?

What is the typical form of word-definition given by children of kindergarten age? What kind of words are they able to define?

Do boys or girls usually have a wider range of information? Cite some possible reasons for this difference.

In what ways do children's drawings throw light on their mental processes?

What are the chief characteristics of the "extrovert"? of the "introvert"? Is extroversion or introversion the more desirable mental characteristic?

How can social and emotional habits acquired in childhood most effectively be modified in later life?

General Characteristics of the Kindergarten Child

The year that the child spends in kindergarten is in many respects a transitional period for him. Physically he is changing from an organism that is growing and changing

very rapidly to one whose rate of growth is much slower. Mentally he is changing from the unforeseeing little child whose conduct is determined almost wholly by the needs and interests of the moment to the older child who works for more remote goals. Socially his interests are reaching out to include more persons. Formerly his preferences for certain persons were determined chiefly by the extent to which they ministered to his bodily needs. Even in his play, his interests centered largely about himself. Although, as we saw in an earlier chapter, children of three and four show the beginnings of truly socialized play, nevertheless their ideas of what play is are still, for the most part, very egocentric. The four-year-old still says, "I want some one to play *with me.*" But a year or so later comes the dawn of a new social concept. Now we more often hear, "I want to go and play *with the other children.*" The child no longer sees himself purely as an individual but is beginning to identify himself with the group.

These changes are to some extent determined by the growth processes that are taking place in the child, quite apart from anything that is done to him. But their appearance is brought to a sharp focus, their pattern into sudden and clear relief, by the great change in environment that comes with the first real break with the home on the child's entrance to kindergarten. Now for the first time he finds himself treated as one of a group rather than as an individual about whose doings and sayings the known world revolves. Now he finds himself in the position of one to whom his associates no longer specially cater. Instead, he must adjust his own desires and convenience to the rules and requirements of those about him. Perhaps for the first time in his life he has no lack of available companionship; but these new companions, unlike the genial mother and father and the good-natured older brothers and sisters he has known at home, show no special desire to play with him.

Instead he finds that if he wants to have any fun in this new place he must be able to play with them.

He has to learn to do many new things that at home have always been done for him. A small acquaintance of mine at the end of his first day in kindergarten called to the teacher, "Hey, Miss Arthur, get me my coat!" The teacher replied, "At school, John, boys get their own coats." Surprised into silence, John made his way to the coat room, but on his return he looked at the teacher reproachfully and remarked, "When I tell my mother to get my coat she gets it. And she gets it *quick*." Although not all mothers are as obedient as this, it is probably true that few of them show sufficient mental agility to keep up with the child's developing ability and allow him the freedom of action and personal responsibility for conducting his own affairs that he is able to take. As long as the child remains in the home, the chances are that he will continue to be ruled by the patterns appropriate to babyhood, or at most that there will be a considerable lag between the child's actual level of development and the kind of treatment that he receives from those who have been accustomed to caring for him at a time when he was less capable of caring for himself. All of us are governed by habit to a greater extent than we are likely to realize. The kindergarten teacher on the other hand, who sees the child for the first time at the age of five and so has no "babyhood habits" to overcome in her management of him, is likely for that very reason to bring out in him qualities of independence and initiative that he has not previously shown, or that, if shown, were speedily repressed and discouraged.

The kindergarten period is then primarily a time when the child's newly acquired abilities and skills lose something of their purely individualistic goals and begin to take on a more socialized character. Running and jumping are still fun in themselves, but they are more lively fun if done in

company and as part of a game. Conversation more often takes on the character of a discussion, of an exchange of ideas and information. Emotional behavior is modified in various ways in order to conform to the ideas and customs of the group. In all his actions and attitudes the child of kindergarten age gives evidence of the dawning of a group consciousness, of a reaching out after companionship not simply for amusement but as a means of extending the range of his own personality. Vaguely but surely he is coming to see that "we" is an expression that carries more weight in the world of affairs than "I" can ever hope for.

Motor Abilities at the Kindergarten Age

The delight in physical activity so characteristic of the younger child shows no signs of abating as yet. By this time, both the child's bodily coördination and his dexterity of hand have advanced so far, while his powers of self-criticism and judgment are as yet at so childish a level that he flings himself into whatever he attempts to do with a whole-hearted abandon likely to be both amazing and disconcerting to his more cautious elders. When he swings he swings hard, when he runs and jumps he runs fast and jumps as far as his legs will take him. But for the most part his motor performances are of the same relatively simple kind that have been delighting him for the past two years. They are performed with greater energy and with fewer waste motions. In doing them the child shows an air of certainty, of confidence in his own skill that previously was less marked or was even absent. But he does not, as yet, make many efforts to learn new and difficult motor skills. He rides a tricycle but not a bicycle, runs and slides but does not use either ice-skates or roller-skates. True, he probably has not been provided with skates or a bicycle, but a year or two later this would be small handicap to his learning how to use them if there were any in his immediate

vicinity that could be appropriated. There is, of course, much difference in these respects from child to child. Some who are specially gifted along motor lines or who are given more than usual opportunity and encouragement to learn the more complicated skills do so much earlier than others. On the average, however, the five-year-old spends much more time in perfecting the motor accomplishments begun at an earlier age than in learning new ones.

Intellectual Traits

Intelligence tests suitable for kindergarten children are many and varied, and the predictive value of a good test given to a child of this age by a skilled examiner is high. From the age of five on, the various revisions of the Binet can be used, and there are also a number of good "performance tests" (so called because they stress motor performance rather than language). Attempts have been made to test kindergarten children in groups as is done with older children, but in general these attempts have not met with unqualified success. In order to bring out the best efforts of a five-year-old, individual attention is still needed in the majority of cases.

A number of new ways of studying the language and thought processes of the young child can now be used. One of these is the "definitions" test. Children are asked to define various common nouns with whose meaning they are well acquainted. The typical five-year-old definition is in terms of use: "a chair is to sit on"; "a horse is to draw wagons"; "a book is to read." More rarely other attributes, such as color or size are mentioned: "an apple is red"; "a baby is little." But definitions in terms of the class to which the object belongs are very unusual at this age, and the complete formal definition which not only names the class but adds a qualifying phrase by which the species can be recognized, such as "A cow is an animal that gives milk," almost

never occur. Before the age of four or five, few children are able to give definitions at all, even for very familiar words. They can only tell you that "a chair is a chair," or, if pressed, they may point to one and say, "That's a chair." Further they cannot go. Even in the child of five or six, the ability to define words is usually limited to nouns, though they will sometimes give an illustrative sentence when asked to define words belonging to other parts of speech or may demonstrate, "Like this," in trying to define verbs that lend themselves to such demonstration.

Children of five or six, after a few preliminary trials in order to give them the idea, can respond to a number of the simpler abstract relationships between words. Given an action they can name the agent. That is, if asked, "What runs?" "What burns?" "What flies?" they will give appropriate answers. They can also name easy word opposites such as "yes—no"; "little—big"; "hot—cold." Giving definitions, giving word opposites, naming the agent of an action, and similar tasks all throw much light on the development of abstract thinking and so are often used as parts of intelligence tests.

The amount and kind of information possessed by kindergarten children regarding the world about them is far less extensive and exact than most people suppose. Children chatter away so glibly on many topics that it is only when their actual knowledge is probed by means of careful questioning that the gaps in their information are revealed. One of the first persons to make an inquiry of this kind was G. Stanley Hall. In an article published in 1891 * he presented the results of a study in which five-year-old children were asked a number of specific questions such as the origin of various articles of food and clothing, the use of certain household articles, and simple facts of local

* G. Stanley Hall, "The Contents of Children's Minds on Entering School," *Ped. Sem.*, 1891, 1: 139-173.

geography. His results showed that children on entering school are likely to be woefully ignorant of many things that their teachers frequently take it for granted that they know. More recently, Probst,* working on the same problem with Minneapolis kindergarten children, found much the same thing to be true. In order to make sure that the hundred kindergarten children whom she studied constituted a fair sample of the Minneapolis population, she consulted the census figures to find what percentage of the adult males in the city belonged to each occupational class (see p. 254). Then the occupations of the children's fathers were ascertained, and enough children from each group were selected to match these percentages exactly. In each group the number of boys and girls was also kept equal. All the children were between five and a half and six years old.

Table 4 shows samples of the questions asked by Probst and the percentages of children who were able to answer them correctly. In this table the column headed U shows the percentage of correct replies given by children whose fathers belonged to the three upper groups of the occupational classification; L shows the corresponding percentage for the three lower groups; B gives the figures for the boys and G for the girls of all groups; T the total percentage of correct answers.

The superiority of the more favored social classes in general information is shown very clearly, not only in these questions but in almost all of the 132 items making up the list. Also there is a tendency, not quite so marked but still very consistent, for the boys to do better than the girls. The social difference is easily understood, but the sex difference is harder to explain. It is not a matter of "general intelligence" of the kind measured by the ordinary "intel-

* Catheryn A. Probst, "A General Information Test for Kindergarten Children," *Child Dev.*, 1931, 2: 81-101. Also M.A. thesis on file in University of Minnesota library.

TABLE 4

SAMPLE ITEMS FROM THE PROBST TEST OF GENERAL INFORMATION AND PERCENTAGE OF CORRECT RESPONSES MADE BY CHILDREN OF DIFFERENT SOCIO-ECONOMIC STATUS AND BY THE TWO SEXES

QUESTION	PER CENT CORRECT				
	U	*L*	*B*	*G*	*Total*
How many eggs in a dozen?	18%	6%	16%	8%	12%
Who was the first president?	68	42	56	54	55
Of what is snow made?	80	70	78	72	75
What did Cinderella lose at the ball?	50	26	40	36	38
On what part of the violin do you play?	52	40	54	38	46
From what are little chickens hatched?	74	52	66	60	63
How many horns has a cow?	84	90	86	88	87
What is paper made from?	32	18	28	22	25
What makes a sailboat go?	60	30	58	32	45
For what is baking-powder used?	92	76	86	82	84

ligence tests," for such a test was tried and it was found that the girls actually did a little better than the boys.

It is interesting to know that wherever tests of general knowledge or information have been tried, all the way from kindergarten to college, it has been almost the universal finding that boys and men rank superior to girls and women. We can only speculate as to the reasons for this difference. Perhaps boys have more curiosity than girls. Perhaps, even at the age of five, they are allowed to run about and investigate things for themselves more freely than girls are permitted to do. Perhaps parents, without being clearly aware of their attitude, nevertheless feel that Johnny should be taught facts, since he will some day grow into a man whose success or failure in life will be affected by the amount of knowledge he acquires, but that a knowledge of facts will be of little service to Mary in her future job of catching a husband. And it is of course possible that the explanation is to be found in heredity: that is, there may be sex-linked genes which, while not actually giving knowledge, may nevertheless predispose one sex more than the other to

go in search of it. Which of these explanations is right or whether the true reason must be further sought for, no one can say at present.

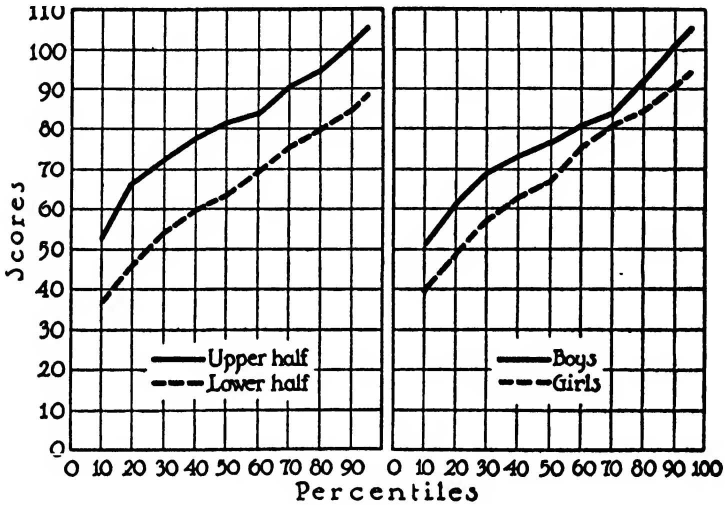


FIGURE 52

RELATIONSHIP OF THE SCORES EARNED BY 100 MINNEAPOLIS KINDERGARTEN CHILDREN ON THE PROBST TEST OF GENERAL INFORMATION TO THE OCCUPATIONAL LEVEL OF THEIR FATHERS AND TO SEX

The curve should be read as follows: Ten per cent of the children whose fathers belonged to the lower half of the occupational classification made scores below 37; 20 per cent made scores below 46; 30 per cent below 54, etc. At every level of ability the children from the upper socio-economic levels do better than those from the lower half and the boys do better than the girls.
(Drawn from data presented in "A General Information Test for Kindergarten Children" by Catheryn A. Probst, *Child Dev.*, 1931, 2: 81-101.)

The Intellectual Factor in Children's Drawings

Primitive man used picture-writing as a means of expressing his thoughts. Modern children draw for much the same reason. They do not, to be sure, make much use of drawing in order to communicate with each other as certain

primitive tribes are said to have done, but this is easily understood since long before a child is able to write for himself he knows what writing is and understands its purpose. To the young child, drawing is more nearly akin to talking to himself than to talking to others. It is a way of making his ideas visible. In this sense it is a language.

Children draw what they know rather than what they see. The truth of this oft-quoted statement has been recognized for decades. The little child does not care whether or not his pictures are beautiful, but he wants them to tell what he has in mind. Details do not trouble him; he goes straight for what is to him the main fact. So if he wants to draw a man with trousers on he draws the man first and adds the trousers afterward. The fact that the legs show through the trousers does not trouble him a bit. The man is there, so are his trousers, and who could ask for anything more complete? If he wants to draw a little girl picking flowers in a field he first draws the girl, then the flowers, then, in order to connect the two, he extends one of her arms down to the flowers at her feet in happy disregard of the laws of anatomy. Armholes may seem to be the most important parts of a coat when one is just learning to find his way into them without help, so it is not uncommon to find the armholes drawn with care on a figure that is otherwise completely nude except perhaps for a hat, which as everyone should know is a far more important part of the drawing than is the hair, for hair stays on with no trouble whereas a hat must be looked after. At the age of five, approximately 35 per cent of children's drawings of the human figure include the hat, but only 13 per cent show the hair. At the age of eight the percentages have increased to 72 and 45, but baldness is still more common than hatlessness.

The changes in children's drawings that take place from age to age as well as many of the differences between the drawings of children of the same age have been shown to be

far more closely related to general intelligence than to special artistic talent in children under the age of ten or eleven years. Older and brighter children less often omit essential parts of a drawing; they show a better sense of proportion; their ideas of the relationship of different parts of a drawing to each other are more definite. Children of four or five in attempting to draw the human figure make all sorts of amusing errors in assembling the different parts. Arms are frequently attached to the head or to the legs, even when the trunk is shown. Legs also are often attached to the head. This is the most logical place to put them if the trunk is omitted, but even when the trunk is added, backward children often continue to attach the legs to the head on either side of the trunk, which is then suspended between them. Sometimes the legs are attached to the arms or even to the brim of the hat.

Little children usually draw the human figure in full-face, but around the age of nine or ten, sometimes earlier, profiles begin to appear. Boys make the change to the profile drawing rather earlier than girls, on the average, but the reason for this is not known. Perhaps it may be the result of a greater interest in physical activity, for it is easier to show a figure in action if the profile position is chosen. All sorts of bizarre errors creep in, particularly with backward children, when this change in position is first attempted. Two noses or two mouths, one in the full-face position and one as it would be seen in profile, may appear in the same drawing; or the nose and mouth may be shown in correct profile, but with two eyes both on the same side of the head. The face may point in one direction, the feet in the opposite. All these errors are much more common among backward children than among bright ones at any age. Indeed the intellectual differences shown in children's drawings are so marked that these drawings have been found to yield a fairly good measure of intellectual development in children

between the ages of five and ten years. Before the age of five many children have not had enough experience with pencil and paper to make their first drawings of much significance, while in older children drawing becomes less wholly a means of expression and passes over gradually into a special talent.*

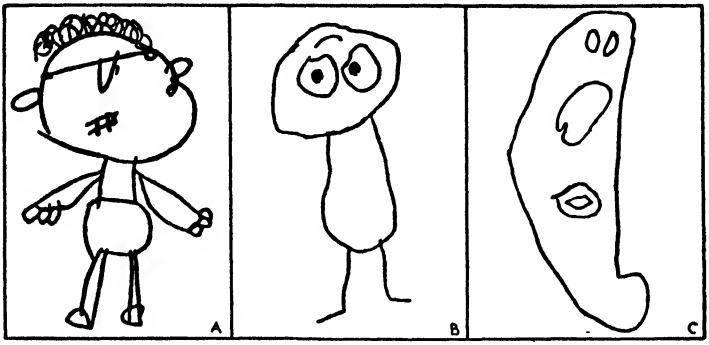


FIGURE 53

DRAWINGS OF A MAN BY BRIGHT, AVERAGE, AND DULL KINDERGARTEN CHILDREN

(From *Measurement of Intelligence by Drawings* by Florence L. Goodenough. Courtesy of World Book Company.)

Figure 53 shows drawings by bright, average, and dull kindergarten children. For comparison, Figure 54 shows drawings of bright, average, and dull children of eight years. Although the drawings by five-year-olds are on the average inferior to those of the eight-year-olds, this is not true in every case. In the present case, the bright five-year-old does distinctly better than the backward child of eight and almost as well as the average child of that age.

The drawings of bright children are not always or necessarily more artistic than those of backward children, but

* Florence L. Goodenough, *The Measurement of Intelligence by Drawings* (Yonkers-on-Hudson: World Book Co., 1926).

they excel in such matters as the number of items shown, the correctness with which the parts have been assembled, the relative proportions of the different parts, and in the control of eye and hand movements as shown by the

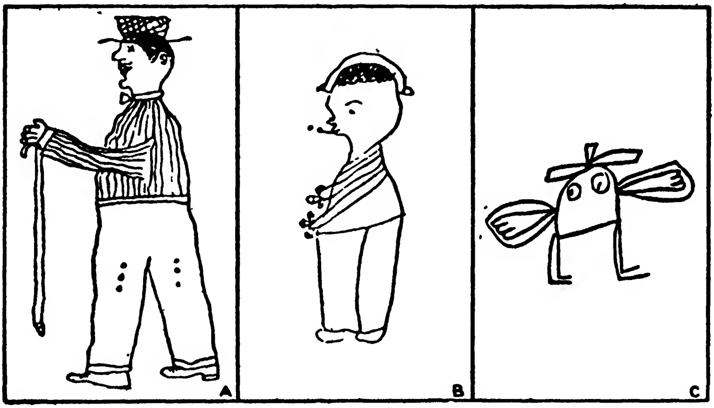


FIGURE 54

DRAWINGS BY BRIGHT, AVERAGE, AND DULL EIGHT-YEAR-OLDS

(From *Measurement of Intelligence by Drawings* by Florence L. Goodenough. Courtesy of World Book Company.)

regularity of the lines and the smoothness of their joinings.

Examples of the queer errors often made in children's drawings of the human figure are shown in Figure 55.

Social and Emotional Behavior in Kindergarten Children

If we consider the great differences in the kind of home training that children receive before they enter kindergarten, together with the probability that there are native differences as well that may predispose toward certain kinds of behavior rather than others, it is not surprising to find that their behavior in kindergarten differs. From the beginning some children get on well. They are popular with the

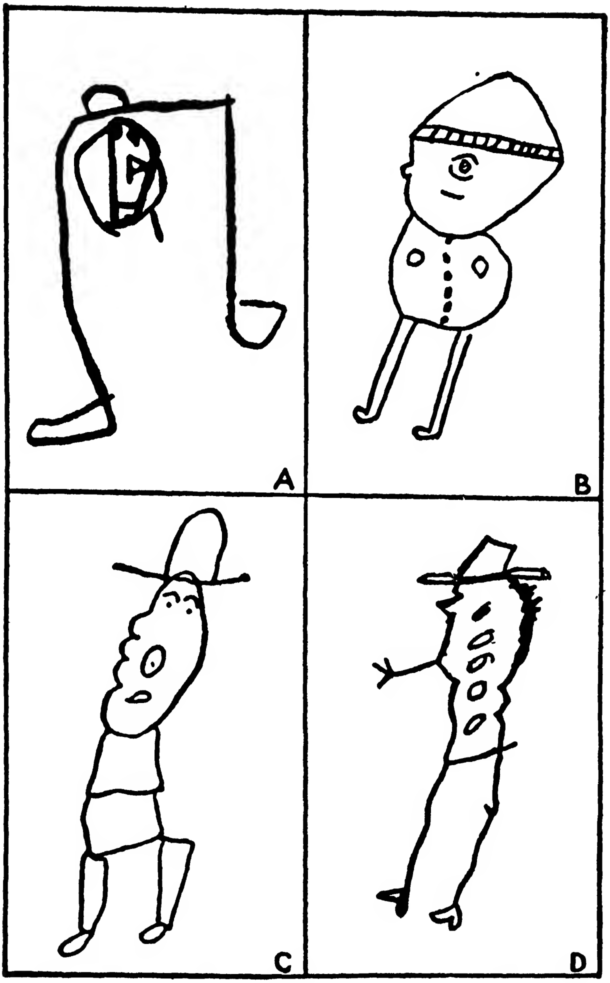


FIGURE 55

SOME ODDITIES IN CHILDREN'S DRAWINGS

Errors of this kind are especially frequent in the drawings of backward and feeble-minded children.
(From *Measurement of Intelligence by Drawings* by Florence L. Goodenough. Courtesy of World Book Company.)

school and kindergarten children of two to six years of age.

In the first part of his experiment he asked the teachers to rate each child on a series of behavior traits supposed to be important for the classification of introvert-extrovert tendencies. The rating scale was made up of a number of paired descriptions, one of which was supposed to typify the introvert, the other the extrovert. The teachers were asked to select the one description of each pair that most closely tallied with the child's usual behavior. If the agreement between the child's behavior and the printed description was close, she was to mark it with two plus signs; if there was only moderate agreement, with one plus. This of course was the equivalent of a judgment that so far as that particular item of behavior was concerned the child was markedly extroverted (if the extrovert side of the scale was given a double plus), moderately extroverted (if given a single plus), moderately introverted (single plus on the introvert side), or markedly introverted (double plus on the introvert side). Teachers were urged to make a definite judgment wherever possible, but if they were quite unable to make up their minds they were allowed to use a minus sign for both traits, indicating that as far as they had observed the child was neither an introvert nor an extrovert but midway between. Numerical values were then assigned to the ratings, ranging from 1 for extreme introversions to 5 for extreme extroversion. There were in all twenty pairs of descriptions. The sum of the scores on all the pairs was taken as the child's final score, thus making a possible range of scores from 20 to 100. Here are some examples.

Introvert trait	*Extrovert trait*
Is self-conscious; easily embarrassed; timid or "bashful."	Is self-composed; seldom shows signs of embarrassment; perhaps is forward or "bold."

Introvert trait	*Extrovert trait*
Deliberative; slow in making decisions; perhaps even on minor matters is overly cautious.	Impetuous and impulsive; may plunge into situations where forethought would have deterred him.
Reserved and distant except to intimate friends; does not form acquaintanceships readily.	Hearty and cordial even to strangers; forms acquaintanceships very easily.
Marked perseveration tendency; does not abandon an activity readily, regardless of success.	Turns from one activity to another in rapid succession; slight perseveration tendency.

In addition to his rating scale, Marston tried out a series of simple experiments planned to set for the child situations that would show up individual differences of the kind in which he was interested. In his first experiment the child was brought into a room where a strange man (Marston himself) was seated at a desk playing with a teeter-tauter. At first no attention was paid to the child, but if he showed no inclination to approach after sixty seconds, Marston raised his head and looked at him without smiling or speaking. Thirty seconds later he looked up and smiled, still without speaking. If there was still no approach on the part of the child, after another thirty seconds he was asked if he liked to teeter-tauter. Thirty seconds later he was given a cordial invitation to approach and play with the teeter-tauter. Thereafter, urging was given at stated intervals until it was evident that no response could be obtained. Numerical scores were assigned to the child's behavior in terms of the length of time before he accepted the toy. If he did not accept it at all, the score was zero. Following are brief descriptions of the behavior of two children, illustrating extreme types of reaction:

1. (Marked introversion.) "E.C., a girl of 61 months quietly stood about four feet from M during the experiment. She returned M's look shyly, and then turned slowly away; she refused to return his smile, but nodded when asked if she liked to teeter-tauter, and nodded again when offered the privilege of playing with the toy teeter-tauter, but made no move to approach. M. assured her, 'You may,' and she turned slowly to face him and the toy. Further urging failed to influence her, and she steadfastly rejected invitations and coaxings, and refused to smile, speak or communicate other than by nodding the head. The toy was placed near her but she didn't touch it."

2. (Marked extroversion.) "B.F. said, 'Hello! What are you doing?' as soon as the screen was removed, and rushed to the table on which the toy was. 'What is this?' he demanded, and in fifteen seconds from the time the experiment began he was playing with the toy."

Other experiments used by Marston were designed to measure "compliance" as indicated by the length of time a child would persist in trying to perform a task that was beyond his ability, the degree of interest shown when the child was taken to a museum of natural history and allowed to run about and examine the exhibits as much as he liked, and self-assertion as shown by his behavior when a different kind of toy was substituted for the one of his choice. It was found that children who behaved in an "introverted" manner in one experiment were likely to show similar behavior in the other situations and vice versa. The results of the experiments also agreed fairly well with the ratings given by the teachers in the first part of the experiment. All this suggests that certain general patterns of social and emotional behavior that carry over from one situation to another have been fairly well established in children by the age of four or five years and even earlier.

We do not know exactly how these differences have come

about nor how permanent they are likely to be. There is a suggestion that as children grow older and gain in social experience their behavior in situations such as those used in Marston's experiments changes. They are more likely to wait for recognition and invitation before demanding that a stranger share his possessions with them. They will stick to a difficult task for longer periods. They perhaps see more possibilities in toys and so more easily become interested in a substitute for the one which first attracted their attention. Whether or not it is fair to say that such changes indicate a greater tendency to "introversion" is another matter.

The girls, in these experiments, behaved in a more "introverted" fashion than the boys, and these apparent sex differences increased with age. Again, difference in social training probably offers an adequate explanation, for quietness, docility, and politeness are virtues that from time immemorial have been cultivated in the training of little girls, while boys are permitted to be more boisterous and aggressive.

Although Marston's method of scoring his rating scale and, to a less extent, the methods used in scoring the children's behavior during the experiments were planned with the idea that most children would fall into one or the other of the two emotional types in which he was interested, his results do not well bear out this hypothesis. Instead of two distinct groups, with only a few intermediate cases, it has been found that most people fall into the intermediate group, with relatively few at the extremes. It appears as though "introversion" and "extroversion" are not really "types" at all but merely the two opposite ends of a single mode of classifying behavior. Just as most people are neither very tall nor very short but of about average height, just as there are more people of near-average intelligence than either idiots or geniuses, so there are more people who are

neither pronounced introverts nor pronounced extroverts but who belong somewhere in between. Sometimes they show one pattern of behavior, sometimes another, according to circumstances. A child may be noisy and obstreperous at home, shy and quiet at school. Moreover, people are far from agreed as to what forms of behavior are most indicative of the social temperament and emotional tendencies ascribed to the introvert or the extrovert. Different authorities emphasize different things.

Probably all that we are warranted in saying about emotional types is that as children grow older they tend to build up certain habits of social and emotional behavior that are shown under a fairly wide number of different circumstances. Their behavior takes on a rather consistent pattern. But we need not suppose that any child is from the start of his life *predestined* to build up one of these patterns rather than another, though it is quite possible that he may to some extent be *predisposed* to do so because of inherited tendencies. These broader and more consistent patterns of emotional and social behavior, like the more limited and variable ones of an earlier age, grow out of the meanings that the child learns to ascribe to the persons and objects round about him. All the time, as he grows older, he is grouping, classifying, generalizing, drawing conclusions, learning what situations belong together and so may be handled in a similar fashion. But the system of classification used will differ greatly from one child to another. Johnny, who has been taught at home that the world is his oyster, who has never been restrained from playing with anything that he can get his hands on, sees the teeter-tauter and at once puts it under the head of "something for me to play with," and he behaves accordingly. To Mary, who has been reared under the rule of "you mustn't touch other people's things," the same situation has a very different meaning, and it is to this meaning that she responds. The fact that

as children grow older their behavior shows more consistent patterns from one situation to another means only that their responses are more often governed by rules, principles, and habits and less wholly by single events. The pronounced extrovert is not a different kind of human being from the pronounced introvert, but he has acquired a different set of emotional and social habits.

Is extroversion or introversion the ideal pattern of social and emotional conduct? Although some persons have put in an unqualified vote for the extrovert, it is safer to hold to a middle ground. Either extreme is likely to be undesirable both from the standpoint of social accomplishment and from the standpoint of individual happiness. The extreme introvert misses many pleasures of social intercourse that might be his if he knew how to take them. His withdrawal from the world of affairs often results in failure to direct his thoughts and endeavors along the most useful lines. His tendency to brood over past happenings is wasteful of time and energy that might better be directed toward present accomplishment. On the other hand, the extreme extrovert is likely never to find out what a good companion one can be for oneself but is restless and unhappy unless he can be one of a crowd. He is so much a creature of the moment that he finds it hard to stick to a job until it is completed, because some new attraction is almost certain to intervene. Action is such a necessity for him that he is likely to plunge into affairs without consideration and so makes many mistakes that a little forethought might have prevented. Better than either extreme is a well-balanced mixture of introvert and extrovert tendencies, in which neither pattern invariably dominates over the other.

If we find that through childhood experiences and training or because of more recent events our own behavior is tending toward one or the other extreme to a greater degree than seems desirable, what can be done about it? Must we,

perforce, be the helpless victims of the attitudes we have previously formed? Do the habits of the child that one was inevitably determine the behavior of the man or woman that one has become?

Habits and attitudes are built up from experiences. With new experiences the meanings that we have previously assigned to a given kind of situation are modified in various ways. If we wish to change our social and emotional attitudes, the way to accomplish this change is to put ourselves in the way of getting the kind of experiences that are calculated to give rise to new meanings. The person who is socially shy and ill at ease, who dreads going out into society or meeting new people, is not likely to get much help by sitting at home and thinking it over. Better for him to make a point of seeing and talking with congenial people, to take the initiative in meeting strangers, perhaps to cultivate a few socializing accomplishments if he does not already know them, such as dancing, bridge, golf, tennis. The first few times may not be easy, but if he persists he is likely to be rewarded by finding that his dread of social contacts is disappearing and is being replaced by a feeling of ease and enjoyment. Not by taking thought but by the gaining of new experiences are we able to add new cubits to our social and emotional statures.

Chapter XVI

HOW OLDER CHILDREN LEARN

What is the chief difference between the learning of pre-school children and that of older children and adults?

Is incidental or purposeful learning usually more dependable? Why?

What kind of material is easiest to learn and remember?

What are some rules for making learning easier?

Does learning one thing made it easier to learn other things?

In what ways does a well-learned action differ from one that is only partly learned?

What are the chief differences between the motor learning of rats and that of school-children? between the learning of school-children and that of adults?

Does continued practice always mean success in learning? Explain.

How does learning by "conditioning" differ from learning by "trial and error"? By what other methods does learning take place?

Do animals or children show an "instinct of imitation"? What part does imitation play in learning? Describe.

General Characteristics of Later Childhood

The period extending from about the age of six until the beginning of pubescence* is a time of relatively slow

* The age of puberty varies greatly from one child to another, but on the average it is reached at about thirteen years in girls and fourteen or fifteen in boys. For a year or more previous to the actual onset of puberty

growth in bodily size, slight change in bodily form and general appearance, and tremendous interest in physical activity. This is preëminently a *period of learning.* By the age of six the child has gained such a high degree of control over his body and its actions and all the basic motor skills have been so well perfected that he is ready to go ahead and learn all sorts of new and complicated acts. Skating, swimming, diving, climbing trees, walking fences, rowing, jumping rope, spinning tops, and dozens of other complex motor accomplishments are mastered during this time. Although many of these new skills are learned and enjoyed for their own sake, as a rule the skill itself is secondary to some game of which it is a part. Baseball, marbles, jackstones, and hopscotch are examples of the many games of motor skill that first become popular at this age. All these accomplishments have their roots in the basic motor skills that all children acquire in the course of normal growth and maturation. But they differ from the earlier and simpler acts in the following ways: they have to be learned, and not all children learn them.

Learning also plays a leading part in the changes in the intellectual life of the school-child. He learns to read, and reading provides him with a mass of new information, stimulates new interests, enlarges his vocabulary. He learns to write and so extends his range of social intercourse to include people at a distance as well as his immediate companions. Arithmetic provides him with a whole series of new ideas and symbols that he is able to use in various ways.

He learns the social codes of his group. As a little child he knew rules only as standards laid down by others to which he was required to conform. Now he begins to take a part in making and enforcing rules. This game must be

certain bodily signs can be observed which indicate that the pubertal changes are on the way. This latter period of transition from childhood to adolescence, which is known as the *period of pubescence,* will be considered in a later chapter along with the period of adolescence.

FIGURE 56

MOTOR SKILLS OF PRE-ADOLESCENT CHILDREN

(Upper photographs by courtesy of J. C. Foster. Lower left photograph from *Physical Training Lessons* by Wm. A. Stecher. Courtesy John J McVey Co)

(Compare with Figure 26 and Figure 72.)

played in such-and-such a way. This act is permissible, that one is taboo. He is no more likely than before to conform willingly to adult regulations, but he is meticulous in keeping up the rites and ceremonies, in adhering to the rules and customs of his group. Grown-ups may criticize him as much as they please; it does not cause him much worry. But he is keenly alive to disapproval or ridicule from his playmates.

With the development of this strong social consciousness, emotional behavior changes. Before, the only check on free emotional expression was the fear of punishment. Johnny learned not to bite or kick when angry because he was likely to be spanked or sent to his room if he did so. But the control was all from the outside. He may have yielded to it, but he did not actively seek to conform to any standard. Now his attitude changes. Certain kinds of emotional displays are labeled by his playmates as "babyish," "sissy," "fraidy-cat." These he must not show, no matter how he feels. Now for the first time we see the child making definite attempts to regulate his own behavior in order to attain a social rather than a purely material goal. It is no longer enough to be able to do certain things; other people must approve of the way he does them. As he identifies himself more and more with the group to which he belongs, he begins to look at himself through the eyes of his associates. With the growth of social consciousness his own conduct takes on a meaning for him that it never had before.

We have said that the period from six to twelve is above all a period of learning. But this is only half the story. Children learn from the beginning, but they learn casually, incidentally. Things happen together and so become associated in their minds. They learn by conditioning, by chance observation, by the random experimentation that we call "trial and error," by imitating others. But, except spasmodically and for short periods, the very little child does not learn by intention. He is not interested in his own per-

formance as such nor does he seek to better it, though he does try to get certain material results. By the age of six or seven, however, a new element comes into his learning which will thereafter play a highly important part in modifying his behavior and extending his range of accomplishments. From then on the child not only learns. He *tries* to learn.

Because learning is such an outstanding factor in determining the behavior of the school-child it will be worth while for us to take time, before going further, to see what psychologists have found out about the way learning takes place. We have already considered one form of learning, the conditioned response, and it should be pointed out in the beginning that some psychologists * are of the opinion that the laws of conditioning will account for all learning, including the so-called "voluntary" acts. Whether or not this is true, there can be no question that the attitude of the learner plays such an important part in all learning that it is well to make some distinction between learning that is intentional, that occurs when the subject knows what he has to learn and tries to learn it, and learning that is accidental, resulting from chance experiences which the subject does not attempt to control. Most of the learning of infancy and early childhood is of the latter kind, but as children grow older, and particularly after they enter school, an increasingly large amount of their knowledge and skill will be gained through their own efforts. The undoubted fact that a part of this change from incidental to purposeful learning is forced upon them by parents and teachers does not alter the fact that it takes place.

* See paper read by W. S. Hunter before the Tenth International Congress of Psychology, Copenhagen, 1932; also radio talk, "How Animals Learn," by the same author, published by The University of Chicago Press.

The Difference Between Incidental Learning and Intentional Learning

What difference does it make whether one learns a thing intentionally or by accident? We can say at once that it makes no difference at all provided that it is actually learned and learned with equal thoroughness. But there's the rub. What kind of things do we learn by accident, and how thoroughly do we learn them?

Several years ago, Myers * undertook to find out something about the precision of incidental observation when there was no particular intent to learn. He asked several hundred people, including business men, college students, high school students, and grade-school children, to draw a rectangle of the same size as a dollar bill and another of the same size as the colored portion of a two-cent stamp. They were also asked to select from a number of circles those of the same size as a cent, a dime, a nickel, a quarter, and a half-dollar. Even bankers and merchants who handle money all day long were decidedly inaccurate in their guesses, though they did somewhat better than those who had had less experience with money.

The subjects were then told that they would be given a spelling test. Six very easy words were dictated as fast as they were able to write them down, but they were not told to try to remember what the words were. As soon as the list had been dictated the subjects were told to turn the papers over and write the words from memory in the order in which they had been given. Not one out of twenty was able to do this without error. On this test the grade-school children did about as well as the adults. Failure to learn was not due to the difficulty of the task but to the fact that the subjects had given their attention to spelling the words

* Garry C. Myers, "A Study in Incidental Memory," *Archives of Psychology*, 1913, No. 26. Pp. iv + 108.

as separate units. They had not tried to memorize the list as a whole.

In another experiment, Myers asked his subjects to count the O's in a group of eighteen letters arranged in three rows of six letters each. There were twelve O's, with the following additional letters interspersed at irregular intervals: X, A, P, I, E, and K. Myers points out that in order to count the O's it must have been necessary for them to see the other letters at least clearly enough to recognize that they were not O's. Nevertheless when, immediately after the O's had been counted, the card was withdrawn and the subjects were asked what other letters they had seen, not one of 390 persons tested was able to recall all six letters correctly. The average number remembered was one. When they were asked how the letters had been arranged, more than half thought there had been four lines of five letters each. Many had failed to notice the color of the letters (bright red) or the color of the background (bright yellow), and few had formed more than a hazy idea of the border by which the letters were surrounded.

Many other experiments have been made with similar results. One of the most common is the "testimony" experiment. Sometimes this experiment is given the form of a mock crime. Before an unsuspecting group of students in a lecture room two or more of their associates suddenly appear and go through the form of a robbery, an assault, perhaps a murder. Immediately afterward or perhaps a day or so later the students are questioned about what took place. Sometimes in addition to answering the questions they are asked to state the degree of assurance they feel in replying, which facts they are uncertain about and to which ones they would be willing to swear. Practically always it is found that many students report that they saw all kinds of things which did not happen at all. Often they feel so sure of these false observations that they would be willing to swear to them,

while many of the actions that really did take place will be found to have escaped notice entirely.

The psychological laboratory provides other evidence as to how little is learned with precision when there is no particular intention to learn. The color-naming experiment is an example. Subjects are shown a series of small disks of different colors arranged in successive rows like a page of print. They are asked to name the colors as fast as they can, beginning at the upper left corner and proceeding from left to right and downward as in ordinary reading. The time required to name all the colors is taken at each trial so as to keep the emphasis upon speed. Nothing is said about learning the order of the colors. One would think, however, that after two or three hundred repetitions, always in the same manner, the order would be learned anyway, whether the subjects tried to do so or not. Not at all. Without the intent to memorize, most students will have made hardly any progress at all toward memorizing. Their attention has been centered on naming each color as a separate unit. They have not thought of the colors as forming a connected series.

All this seems to show that we learn very little about the events taking place around us unless something about them attracts our attention. Even then, what we learn is limited almost entirely to the particular thing that we chance to notice, while other and perhaps more important features may be overlooked entirely. The trouble with incidental experience is not that it doesn't teach us anything, for it usually does, but we can't be sure just what it is going to teach.

Selecting the Thing to Be Learned

I know a woman who had great difficulty in recognizing people even after she had met them a number of times. Often she was embarrassed by her failure to recognize

persons whom she should have known at once. Finally she decided to try and look into her difficulty. She found that much of her trouble was due to her habit of noticing people's clothes rather than their faces. If they happened to be dressed differently when she met them a second time, there was nothing by which she could recognize them. After she found out what was wrong and made a definite effort to see the persons themselves rather than their clothing, there was much improvement.

Children and older people as well often fail to learn because they do not center their attention on the right things. A child of ten has to learn how to spell the word *niece*. He repeats the letters over and over to himself, but he gives no more attention to one letter than to another. As a matter of fact, while his lips and tongue are moving silently and he therefore takes it for granted that he is "studying," his fingers are busy with the marbles in his pocket and his mind is rehearsing the particular kind of "shot" by which he plans to defeat all his rivals as soon as school is over. One hundred repetitions! But when he is called upon to write the word he spells it *neise*.

Now in reality, no study at all was needed for him to know that the first letter of the word in question is *n*. He could tell that by the sound. What he chiefly needed to notice was the *ie* following the *n*, and the fact that the sibilant sound is given by a *c* instead of an *s*. The final *e* would require only a moment's notice, since it follows the general rule that monosyllables containing a long vowel sound end in *e*. One minute of attentive study devoted to the parts of the word on which study was needed would have been worth far more than the hundred or more monotonous repetitions with the mind elsewhere.

In all learning, intelligent selection of the things to be learned is of utmost importance. It does not pay to spend one's time and effort in learning trivial details while the

main issues are overlooked or to give as much attention to the familiar and obvious parts of a task as to those which are new or difficult. The school-child who is only just beginning to learn how to study a lesson or to play a musical instrument or to perform some complicated act of skill cannot be expected to know how to direct his efforts most effectively without help. But it is easy to find grown men and women whose methods of learning are as childish and inefficient as those of the average six-year-old. Sometimes this is because they are really stupid; often it is just because they have failed to acquire good habits of learning. They read a book with the intention of remembering it, but they grasp blindly at every detail and in their attempt to retain everything they come out with only a confused impression that has little meaning at the time and is soon lost. Or they read through it mechanically with their thoughts somewhere else and then wonder why they remember so little. Although it is never too late to correct bad habits of this kind, it is better to form good habits from the start. In the education of the school-child nothing is more important than this. He should learn how to learn.

What Kind of Material Is Easiest to Learn and Remember?

Here is a list of twelve nonsense syllables. Try to learn them in order. Keep count to see how many times you have to read them before you can recite them all without a mistake:

Mup, sil, fut, wal, lub, seg, yin, taz, bip, ler, ron, pij.

Now try this sentence, which contains twelve one-syllable words.

The boy tore a great big hole in his new red coat.

How many readings were required to learn the list of nonsense syllables? How many for the sentence?

To-morrow see how many of the nonsense syllables you can recall. And see if you can still remember the sentence.

Material that has meaning, that is knit together to form a connected whole, is easier to learn and is remembered much longer than the same amount of material made up of disconnected bits that have to be memorized separately. Children often have difficulty in learning because they do not comprehend the material that is given them to learn. One way of making learning easier is to try to get as much meaning into the thing to be learned as possible. Modern educators realize this principle and so try to have a large share of the child's school work revolve about actual, meaningful experience. Children learn to make change by playing at store-keeping, they learn geography by making maps for themselves which they ornament with actual samples of the products of the different regions. Mississippi gets a tuft of cotton, Pennsylvania a lump of coal and a bit of iron, Minnesota some grains of wheat. The child who has once helped to construct a map of this kind is far less likely to forget the facts he has learned in making it than the one who has spent his time studying the same facts from a printed book.

Bassett,* in a study of factors influencing retention of history by grade-school children, found that children who stood high in a test of comprehending historical material—that is, those who got the most meaning from reading a history lesson—not only did much better on a test given immediately after the lesson had been studied, but they remembered it for a longer time than those whose comprehension was poor. Children who showed poor understanding of the lesson at the time not only remembered less immediately afterward but soon forgot even the little that they

* Sarah J. Bassett, "Retention of History in the Sixth, Seventh, and Eighth Grades with Special Reference to the Factors That Influence Retention," *Johns Hopkins Studies in Education*, 1928, No. 12. Pp. viii + 111.

had learned. All children were more likely to forget abstract and technical facts than those which were more vivid and concrete, and all were inclined to mix up facts such as dates, names, and places which had little or no logical connection with the events to which they belonged.

Individual interest plays an important part in determining what kind of material will be best learned. In Bassett's study the children who stated that they liked history best of all their studies remembered their history lessons better than their classmates who preferred other subjects.

When material that has few logical connections within itself has to be learned—for example, dates, lists of persons or places, etc.—it is often helpful to build up artificial associations at the start in order to get the facts firmly anchored in the mind. Rimes and jingles may be invented. When I was a child, much of the content of our geography lessons in the primary grades consisted in the memorizing of States with their capitals, principal rivers, and so on. Since at that tender age few of us had any clear idea of what was meant by a "State," and a "capital," if it meant anything at all, was the kind of letter that must be put at the beginning of a sentence on penalty of being "kept in" at recess time to correct one's errors and repent, the whole performance was pretty much on the level of memorizing a list of nonsense syllables. But one enterprising teacher found a way to lighten the task. She set the whole thing to the tune of "Yankee Doodle," and to this day fragments of the ditty remain in my mind.

"Pennsylvania—Harrisburg
Upon the Susquehanna;
Oh, Pennsylvania—Harrisburg
Upon the Susquehanna."

"State of Maine—Augusta
Upon the Kennebec River

Many a person has mastered the date of the discovery of America by means of the well-known rime

> "In fourteen hundred and ninety-two
> Columbus sailed the ocean blue."

Calendar reform might have been forced from sheer desperation long ago had not the present system been made endurable by the help of "Thirty days hath September."

Is It Easier to Learn in Wholes or in Parts?

A common way of having children memorize poetry is to teach them a line or a short stanza at a time and then try to have them put the bits together into a whole. But experiments have shown that this is usually not the best method. One learns most easily when meaning is most vivid, and to break up meaningful material into parts almost always results in a loss of associations that would be helpful in learning, even though not all the thought is lost by the division. Sometimes, however, if the selection to be learned is so long that the task of learning it all at once seems overwhelming and the apparent lack of progress when the attempt is made leads to discouragement and loss of interest, better results are obtained by dividing it into sections, taking care to make the division at points where there is some break in the thought so that as little of the meaning will be lost as possible.

A common example of the wastefulness of learning in parts what should be grasped as a whole is seen in those persons who fail to make preparation for a task in advance and so have to be continually stopping their work to hunt up needed tools.

Observe two students preparing a lesson. One gets his materials ready before he starts and puts them where he can lay his hands on them as needed. The other begins to read his assignment, then decides he had better take notes

and goes for his note-book. Then he must make a search for his fountain-pen. A little later he finds that the pen is going dry and what can have become of the ink bottle? Found at last, but when the pen is filled he has nothing to wipe it on and in consequence his hands become so daubed with ink that he has to stop once more in order to wash them. Ten minutes later he realizes that he is still wearing the heavy shoes he put on for hiking in the afternoon, and so another halt ensues while he changes to his slippers. Then when at last his reading is done he complains that he doesn't have any idea what the darned stuff is all about!

Of course he hasn't! The continued breaks in thought resulting from all these interruptions have so destroyed continuity that the task becomes about as difficult as learning a list of nonsense syllables. The importance of advance preparation in enabling one to carry through an entire task without interruption to the train of thought is something that the school-child can hardly learn too early or too thoroughly.

The Value of Self-Testing or Reciting to Oneself

After one has determined or has been shown just what it is that he needs to learn, what is the best way to set about it? Suppose that it is a passage or a poem to be learned by heart. One way to learn it is to read it over and over again, but this is not the quickest method nor the one that makes for best retention over a period of time. It is better to spend part of the time in trying to recite it to oneself. If, instead of learning by rote, the task is that of learning the general content of a history lesson or a geography lesson, the same principles hold good. First the assignment should be read through one or more times in order to get an idea of the general drift and to decide what are the important things to be remembered. Children should be taught to do this as

soon as they begin to read for information. Afterward, reciting the main facts to oneself and checking up to see what has been omitted will result in much better mastery of the material than will be had from spending the same amount of time in merely reading the assignment over again and again. Not only will the lesson be learned more quickly by this method, but it will not be so soon forgotten.

Tables 5 and 6 give you an idea of how much time and effort can be saved by following this plan. They are taken from a study by Gates.*

TABLE 5

SCORES EARNED IN AN EXPERIMENT ON MEMORIZING NONSENSE SYLLABLES WHEN DIFFERENT PERCENTAGES OF THE TOTAL TIME WERE DEVOTED TO SELF-TESTING

(After Gates)

SCHOOL GRADE	PERCENTAGES OF TIME SPENT IN SELF-TESTING				
	0%	20%	40%	60%	80%
4	9.5	12.0	16.1	17.0	20.0
6	13.2	20.2	22.6	25.2	30.5
8	16.9	23.9	25.8	27.3	35.5

TABLE 6

SCORES EARNED IN AN EXPERIMENT ON LEARNING BIOGRAPHICAL DATA WHEN DIFFERENT PERCENTAGES OF LEARNING TIME WERE DEVOTED TO SELF-TESTING

(After Gates)

SCHOOL GRADE	PERCENTAGES OF TIME SPENT IN SELF-TESTING					
	0%	20%	40%	60%	80%	90%
4†	14.6	16.9	16.4	18.8	17.6	17.2
6	15.1	16.6	18.0	17.7	17.8	16.6
8	20.8	22.4	24.8	25.0	25.3	23.8

† The fourth-grade children were given easier material than those in the upper grades. This accounts for the small apparent change in performance from the fourth to the sixth grade level.

In the experiment employing nonsense syllables it was found that in every grade more than twice as many syllables were learned in a given length of time when the children

* Arthur I. Gates, "Recitation as a Factor in Memorizing," *Archives of Psychology*, 1917, No. 40, pp. 105.

spent 80 per cent of their time in reciting the list to themselves as when they merely read the syllables over and over without testing out their progress. Fourth-grade children who spent 60 per cent or more of their time in reciting to themselves learned as rapidly as eighth-grade children who merely read without reciting. When meaningful material in the form of short biographies of famous men was used instead of the nonsense material, it was found better to spend a little greater proportion of the time in reading and a little less in reciting, but here, too, learning was improved by spending a part of the time in self-testing. For the biographies, the best division of time seemed to be about 40 per cent reading and 60 per cent reciting; for the nonsense syllables, at least 80 per cent of the time might profitably be spent in reciting.

The Distribution of Practice

Are one or two long practice periods or several short ones with time in between more effective for learning? Many experiments have been carried out in an attempt to answer this question. The results have usually been in favor of a number of short periods spaced some time apart rather than longer periods occurring close together. The rule is usually stated as follows: Distributed practice is better than massed practice. But of course such a statement needs to be qualified, for it would be absurd to suppose that the shorter or the further apart the practice periods, the better will be the learning. Really what it means is that a proper distribution of work periods and rest periods (or periods involving a change of occupation) makes it easier to learn, and that people in general are more likely to err on the side of making their study periods too long and too close together rather than the reverse. This is especially likely to be the case when the learning is to be done by children and the length of the practice periods is determined by teachers or

parents, for it is less bother to keep children plugging away at a single task than to be always finding a change of occupation for them.

It is impossible to lay down any single fixed rule as to the best length of the practice periods or how long a time

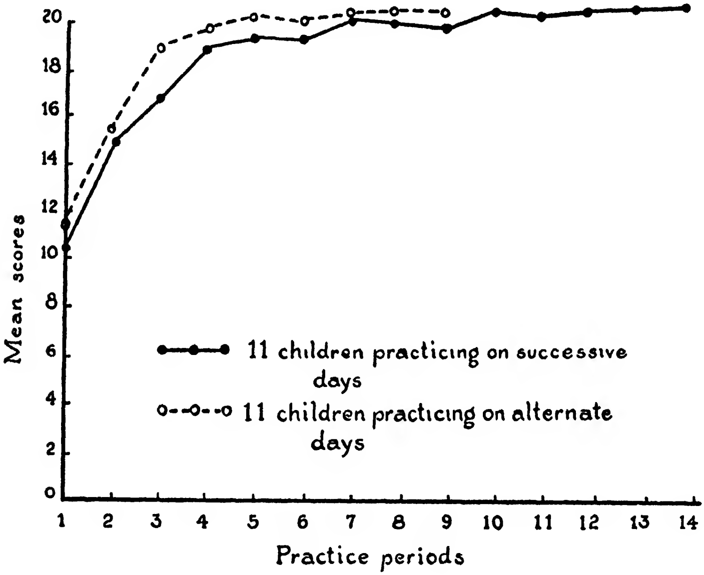


FIGURE 57

LEARNING CURVE OF CHILDREN PRACTISING ON ALTERNATE DAYS COMPARED WITH THAT OF CHILDREN PRACTISING ON SUCCESSIVE DAYS

(After Kirkwood from "Learning in Children" by Joseph Peterson in *A Handbook of Child Psychology,* edited by Carl Murchison. Courtesy of Clark University Press.)

should elapse between them, for it will vary according to the kind of thing that is being learned and the age and mental characteristics of the subjects. In general we may say that in tasks made up of many short independent units, such as learning to throw at a target or learning a spelling lesson,

greater efficiency is gained by distributing the practice over a large number of very short periods than by massing it all into a few longer ones. Kirkwood,* in a study in which children under seven years learned to associate pictures of common objects with geometrical forms roughly resembling them (such as a diamond-shaped block to be matched with a picture of a kite), found that children who practised on alternate days required fewer trials to learn the series than those who practised daily. (See Figure 57.) The length of the practice periods was the same for both groups.

Long † had two groups of ten-year-old boys practise dart-throwing. The first group had ten throws a day, four days a week; the second group twenty throws a day, two days a week. The first group made fewer errors than the second. (See Figure 58.)

Other experiments on the learning of the so-called "drill" subjects in school have given similar results. It has been found, for example, that in teaching primary number work, practice periods as short as two minutes are desirable for the youngest groups, although the time may be increased somewhat for the older ones. But when the material to be learned involves the setting-up of a train of ideas, as in literature, history, or science, it is wasteful to make the practice periods so brief that meaningful associations are cut short before they are fully developed. Interest also plays an important part. If the task to be learned is monotonous and uninteresting, the practice periods should be shorter and further apart than is necessary when enthusiasm runs high. As a matter of fact, it is very possible that most if not all of the advantages coming from distributed practice are due to the greater zest with which even a task that is intrinsically uninteresting will be attacked if practice is

* Julia A. Kirkwood, "The Learning Process in Young Children," *University of Iowa Studies: Studies in Child Welfare*, 1926, 3, No. 6. Pp. 107.

† Quoted by Joseph Peterson in *A Handbook of Child Psychology*, Carl Murchison, ed. (Worcester: Clark University Press, 1931). See pp. 328 ff.

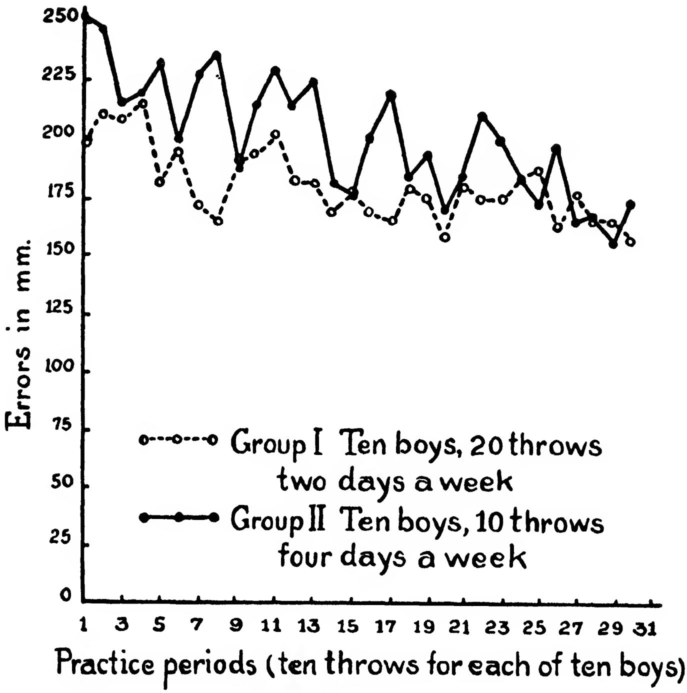


FIGURE 58

AVERAGE ERRORS IN DART-THROWING MADE BY TWO GROUPS OF BOYS UNDER DIFFERENT CONDITIONS OF PRACTICE

(After Long from "Learning in Children" by Joseph Peterson in *A Handbook of Child Psychology,* edited by Carl Murchison. Courtesy of Clark University Press.)

never carried to the point of fatigue and boredom. Learning is an active process. Just going through the motions doesn't help much.

Continued Practice or "Overlearning"

A list of nonsense syllables learned to the point of one correct repetition with no further practice will soon be for-

gotten. Ebbinghaus,* who conducted the first extensive study on memorizing and to whom we are indebted for the first experimentally determined "curve of forgetting" (see Figure 59), found that more than half of a list so learned would be forgotten within an hour and that by the end of a few months practically no memory of it would remain.

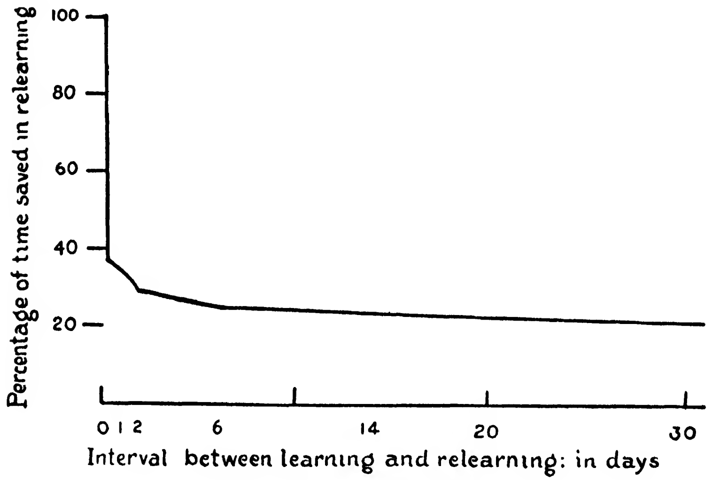


FIGURE 59

THE CURVE OF FORGETTING FOR NONSENSE SYLLABLES LEARNED TO THE POINT OF ONE CORRECT REPETITION

(After Ebbinghaus from E. L. Thorndike's *Educational Psychology*, Vol. II. Courtesy of the Bureau of Publications, Teachers College, Columbia University.)

The twenty-six letters making up the English alphabet bear a fairly close correspondence to a list of nonsense syllables, since there is no logical connection from letter to letter. But all of us go not merely for hours but for days, weeks, perhaps even months at times when we chance to

* H. Ebbinghaus, *Über das Gedächtnis*. See also translation by Ruger (New York: Teachers College, Columbia University, Bureau of Publications, 1913).

have little use for a dictionary without reciting the alphabet or thinking anything about the order of the letters. Nevertheless we do not forget it, and when the need arises we run through the letters as smoothly and with as little hesitation as if it had been recited half a dozen times daily.

The amount of practice after the original learning is

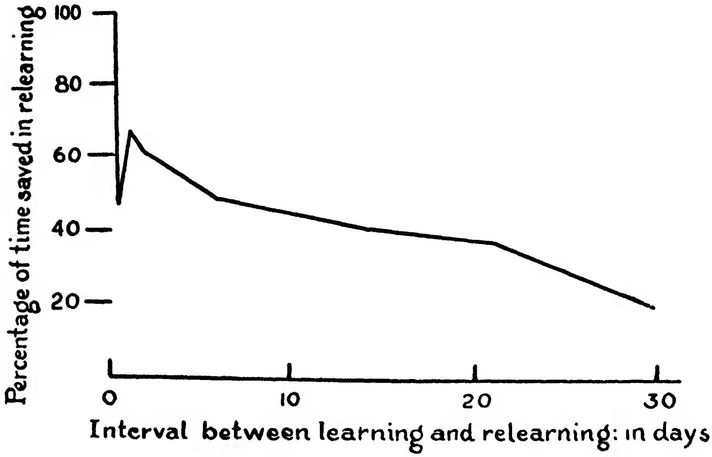


FIGURE 60

CURVE OF FORGETTING FOR NONSENSE SYLLABLES LEARNED TO THE POINT OF TWO CORRECT REPETITIONS

(After Radossawljewitsch from E. L. Thorndike's *Educational Psychology,* Vol. II. Courtesy of the Bureau of Publications, Teachers College, Columbia University.)

what makes the difference. Anything that is just barely learned and never used again will soon be forgotten, particularly if it has no logical connections or personal associations to make it stick in the mind. But even a little additional practice aids retention, and material that is greatly "overlearned" or skills that are practised over and over again are retained so well that the ordinary lifetime is not long enough for them to be completely forgotten. It is said that a skilled

swimmer never entirely forgets the art even though he may go for many years without practice. A student who had practised typewriting for 200 hours dropped it entirely for a year, but an hour's practice was sufficient to make up all the ground that he had lost. Four people practised ten minutes daily for seventeen weeks in reading ordinary prose in a mirror. After two years without further practice all regained their previous levels in less than a week's time by practising the same amount daily as before.

Figures 59 and 60 illustrate how much retention can be improved by even a small amount of overlearning. Figure 59 shows the rate of forgetting nonsense syllables practised to the point of one correct repetition only. Figure 60 shows the rate when two correct repetitions are required before practice is discontinued.

The way to remember is to review, and to review early, for the time immediately after learning is the time when forgetting is most rapid, as you can easily see by looking at the curves. The best kind of reviewing is that which comes with putting the material that has been learned to some actual use, for use gives it more vivid and personal meaning, which, as we have seen, is one of the chief factors that make for retention. One reason why we remember the order of the letters in the alphabet so well is because we have so often made use of that order in consulting dictionaries, encyclopedias, and indexes. With plenty of additional practice to fix the newly learned accomplishment in mind and occasional reviews thereafter to renew efficiency when it has lapsed through disuse it seems safe to say that anything that has been once learned can be retained as long as it seems worth while to make the necessary effort to do so.

The Transfer of Training

Does learning one thing make it easier to learn something else? Can the ability to learn be improved by practice?

A generation or two ago it was believed by many people that all formal studying, that is, studying with the intent to learn, had a disciplinary effect upon the mind of the student which made learning easier for him thereafter. The study of abstract subjects such as mathematics or Latin was assumed to have a marked effect upon the student's ability to learn other things, while studying the more concrete subjects such as drawing or cooking had less effect upon general learning ability.

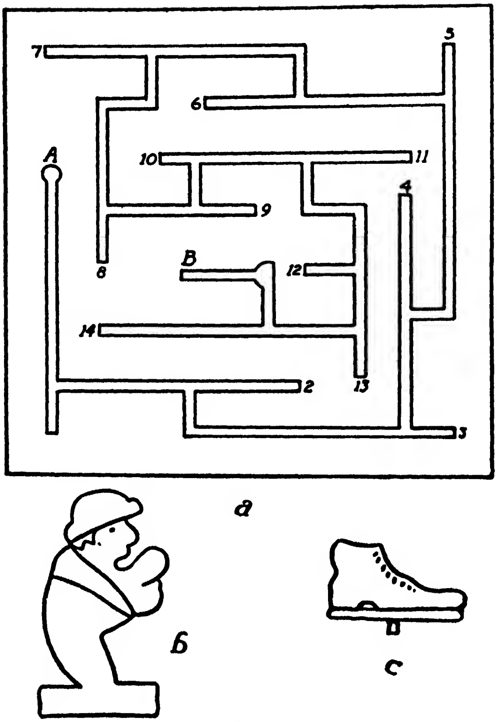
Experiments on the effect of practising one thing upon the ability to learn other things have usually shown that, while there is often some apparent transfer from one form of learning to another, this transfer can in most cases be accounted for by the fact that the two things to be learned have some elements in common with each other. The student who already knows French can learn Italian more easily than another of equal ability who knows only English, because French and Italian are so much alike. A knowledge of French will be less helpful in learning Chinese, but some transfer is to be expected even here, for there are a number of special habits or devices that are useful in learning languages in general which will be carried over from the learning of one language to the learning of another, even though the languages themselves may be of very different origin. But learning French will not have much effect upon one's ability to learn to drive an automobile. The amount of transfer from one learning situation to another is dependent upon the number of common elements in the things to be learned and upon the possibility of utilizing similar methods in learning them.

The Learning of Motor Skills

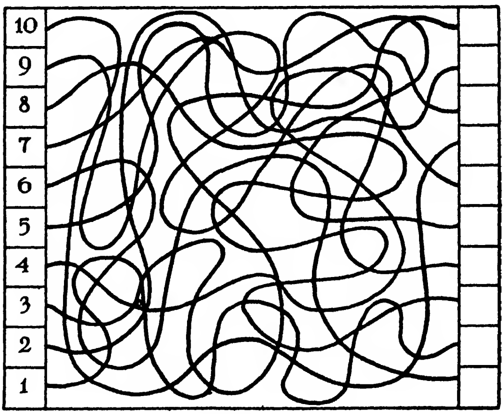
In many ways the learning of children at the ages we are now considering differs but little in principle from the learning of younger children, or of adults or even animals. This is perhaps more nearly true in the acquisition of motor skills than in any other form of learning. Yet differences exist, and a study of these differences provides some excellent examples of the changes in behavior that come about as development proceeds.

A very common method of studying motor learning is by means of mazes. A maze consists of a series of alleyways opening one out of another in such a way that a subject who is put into the maze at the starting point can, if he takes the right turnings, find his way through to a goal at the other end. But all along the way there are blind alleys known as *cul-de-sacs* and as these are not marked in any way he has to learn by experience, by trial and error, which is the right way to go. Mazes are of many kinds, and they vary enormously in pattern and complexity. Those intended for use with animals are made large enough for the animal to run through them. But because mazes large enough for human beings to run through as an animal does are rather awkward pieces of laboratory equipment, most of the work done with children and adults has been with smaller mazes to be traced by hand. Sometimes the subject is allowed to do this with his eyes open, but more often he is required to work blindfolded or the maze is placed under a screen where he cannot see it. "Eye mazes" in which the path is traced by the eye alone have also been used as well as mazes in which a groove is traced with the point of the great toe. Examples of different types of mazes are shown in Figure 61.

In maze work with animals a food box is ordinarily placed at the goal and the experiment is carried out when



A



B

C

FIGURE 61

DIFFERENT TYPES OF MAZES

A. The Young Slot Maze (*opposite page*)

The toy clown is set into the groove at B, the shoe is placed at A. The child is told to take the shoe to the man.

(From Esther McGinnis. The acquisition and interference of motor habits in young children *Genet Psychol. Monog.*, 1929, 6. 234. Courtesy Clark University Press.)

B. An eye maze (*opposite page*)

The lines must be followed with the eye only. The ending of each line is to be indicated by placing its number in the appropriate space in the column at the left.

C. The rolling ball maze.

By tipping the frame the ball is made to roll through a pattern marked out by the screws in such a way that it cannot be perceived visually but has to be determined by trial and error. The mechanical counters underneath register the number of movements taken to complete the pattern.

(After Mattson by courtesy of the University of Minnesota, Institute of Child Welfare.)

the animal is hungry so that he will have a real incentive to reach the goal as soon as possible, once he has discovered that food is to be found there. Of course he does not know this the first time he is put into the maze, but the fact that he is hungry is likely to make him restless. So he goes sniffing and exploring about, entering first this alleyway and then that, doubling on his tracks many times, but finally, if given enough time, discovering the food. The next time he is put into the maze he will go through the same kind of performance, but the chances are he will not cover the same ground so many times and will get to the food a little sooner. Now if further trials are given he will do better and better each time until before long he will start running at top speed as soon as he is put into the maze and go straight through on the correct path without even pausing at the blind alleys and so reach the goal in a small fraction of the time it took him at the beginning. He has learned two things. First, he has learned that food awaits him at the end of the maze, and so instead of sniffing around, perhaps sitting down without moving, or running aimlessly back and forth, he makes straight for the food by the road that he has learned will take him there, and he does not linger by the way. His behavior has lost its random character and has become *patterned,* as always happens when one has a definite aim in mind and knows how that aim can be accomplished. Secondly, he has learned just which turnings to take and which to avoid. And he has learned them so well that he anticipates them in advance. While he is dashing around one corner he is getting set to run just so far and no further before he swerves again. This has been shown by experiments in which the length of an alley has been shortened after the rats had learned to run the maze without errors. It is found that the rats in such an experiment will run full tilt up against the wall at the point where the runway has been cut off. You and I do

the same thing at times and for the same reason. Have you never misjudged the height of a chair on which you were about to sit down and fallen with an embarrassing thud the last few inches after your muscles had relaxed in anticipation of a support that failed to appear? And on negotiating a moderately familiar stairway in the dark, have you never experienced the shock of having the floor seem to rise to meet you when the bottom is reached a step sooner than you expected?

This anticipation of the next thing to be done in the course of running off a learned reaction is often spoken of as the "overlapping" of elements in a pattern reaction and it is one of the chief reasons why a well-learned action seems to be done so smoothly and evenly as contrasted with the uneven, jerky, disconnected movements that are characteristic of the beginning stages of learning. At first the learner has to give his entire attention to the thing he is doing at the moment. He cannot spare any thought to the question of what is coming next. The present task requires his entire effort. But as the separate parts are gradually mastered, he begins to look ahead and prepare himself for the next stage while he is actually carrying out the last. Then, and not until then does he become able to pass from one part of his performance to the next with no apparent breaks or irregularities.

The importance of this overlapping of elements in learning a serial reaction is nowhere better shown than in reading. The child just beginning to read, the older person of little education, or you, when you are beginning a foreign language, must give so much attention to each separate word that the reading of a paragraph is likely to be slow, halting, jerky, and disconnected. With gain in skill, however, certain familiar or striking phrases begin to link themselves together and when you come to these passages your reading, for the moment, runs along smoothly. Your eyes look ahead

for the next words while your lips are pronouncing those seen an instant before. One of the chief things that distinguishes the good oral reader from the poor one is the extent to which his eyes and his understanding are able to keep ahead of his voice. This makes it possible for him to vary his tonal inflection as he goes along instead of having to wait until the thought of the passage is completed, when it will be too late.

In all aspects of everyday life, the factor of overlapping elements or anticipation of the second and third steps while taking the first marks off the efficient worker from the inefficient one. Watch two housewives in their kitchens. One steps briskly about her tasks without hesitation, planning for one thing while doing another, taking advantage of the moment while the dish pan is filling to get the tea-towels ready, reaching for the flavoring extract with her left hand while stirring her cake with the right. The other "putters" about, perhaps moving just as fast or faster, but everything she does requires a separate effort of mind and body. She carries in the broom, then goes back for the dustpan; later still another trip must be made for dust-cloths.

The secret of a smooth and well-organized motor performance lies in the ability to keep the attention centered on what is coming rather than on what is being done at the moment. The tennis player judges the angle at which the ball is coming and adjusts his stroke accordingly. If he waits for it to arrive before making his preparations to receive it, he will be too late. If he stops in the middle of his stroke to think how he is holding his racquet, whether or not his feet are at the right angle, the ball will escape him before he gets around to striking at it. But in order to free his attention from the activity of the moment and center it on preparing for the act that is to come two things are needed. First he must have learned by experience to *interpret* the sensations coming in from his muscles and

joints in such a way that he gets a continual check-up as to whether he is right or wrong. The skilled tennis player does not have to look where the ball has gone to know, within rough limits, whether his play has been good or bad. He knows by the "feel" of it. That is, the kinesthetic * sensations that accompany his act have taken on meaning for him and this meaning is so tied up with the perception of the ball coming toward him at a particular angle that the one is translated in terms of the other. Learning the theoretical principles of correct playing will prevent the development of many bad motor habits that might otherwise be set up but only actual practice and plenty of it will serve to transfer this knowledge into the world of kinesthetic meanings where it will be of real service.

But if one had to give separate attention to each tiniest part of an act, if one had to think separately about holding the racquet, moving the feet, raising the arm, bringing it forward with just so much force and no more, and then keep track of each of the kinesthetic sensations resulting from these acts in order to know whether or not the play was right, the situation would be quite as bad as that described in the well-known rime:

> The centipede did very well
> Until the ant in fun
> Asked, "Pray, which leg goes after which?"
> Then left him helpless in the ditch
> Considering how to run.

Evidently too much attention to the separate parts of an act can impede learning. Before a high level of efficiency can be gained, the simple and elementary units of which an act is comprised must be bound together into larger patterns that are performed as wholes. In many of the ordinary acts

* *Kinesthetic* refers to the muscular sense. Kinesthetic sensations have their starting point in the proprioceptors in the muscles and joints.

of life so much of this organizing process takes place at a very early age that long before the child enters school we find the patterns already laid down and operating so smoothly and efficiently that only by a careful process of analysis can we break up the act into its original units. The psychological laboratory, however, has thrown some light on how the original process of consolidation takes place. In this connection an experiment on the learning of telegraphy, carried out many years ago by Bryan and Harter,* has been much quoted. They studied the progress of a number of students who were learning to send and receive messages by telegraph. Learning curves were plotted for each student, showing the weekly gains in the number of letters he was able to send or receive per minute. They found that the practice curves for sending were not unlike those characteristic of maze learning. There was rapid gain at the beginning with slowing off later on, making the kind of curve that we describe as *negatively accelerated* because gains become less per unit of time as practice increases. The curves for receiving, however, were found to have a peculiar steplike form in which an initial period of gain was followed by a period when little or no advancement seemed to occur. To such a period Bryan and Harter gave the name of *plateau.* Their explanation for the plateau is this: In the beginning the student who is receiving listens to the clicks of the instrument and spells them out letter by letter. All his attention goes to the letters. He does not attempt to group them into words until after he has taken them down on paper. At first he does this very slowly but as he becomes accustomed to the sounds his speed improves. Presently he is taking down the letters about as fast as he can hear them separately. Now it seems as though he could make no further gain and as a matter of fact he does not gain

* W. L. Bryan and N. Harter, "Studies in the Physiology and Psychology of the Telegraphic Language," *Psychol. Rev.*, 1897, 4: 27-53.

much for a while. But sooner or later a new factor comes in. He hears the letter *t* but instead of writing it down at once he waits to see what else is coming. Yes, it is *h, e,* and the word is *the.* Now he begins to listen to the clicks in a new way. Instead of hearing each short letter-group separately, he learns to recognize the longer patterns that go to make up entire words. Now his speed begins to improve again and he gains rapidly for a time as more and more "word-habits" take the place of the slow and laborious "letter-habits" that he used before. After he has learned to recognize most familiar words with ease the gain in speed begins to slow off once more, but it may pick up again if, as the best operators do, he begins to form "phrase-habits" or "short-sentence habits" which enable him to work in still larger units.

The ability to recognize words as wholes without giving separate attention to the letters has two advantages. The telegrapher who has learned to do this hears and recognizes a whole word almost as easily as he can hear and recognize a single letter, just as you do when reading from a book. Think how slowly you would read if you had to pause and look at each of the separate letters of each word before you could tell what it is. In addition to the enormous gain in speed made possible in this way, there is a further gain due to the fact that, when large rather than small units are employed, the overlapping of the two acts involved in the perceptual process of hearing and understanding the clicks and in the motor performance of taking down the message as it is heard is facilitated. There is time to write the last word or phrase while listening to the next. The individual letters come so close together that one cannot keep far ahead of them, but if words or phrases are heard as wholes there is ample time, while each is being completed, to write down what was heard before.

The appearance of a platéau in a learning curve, that is

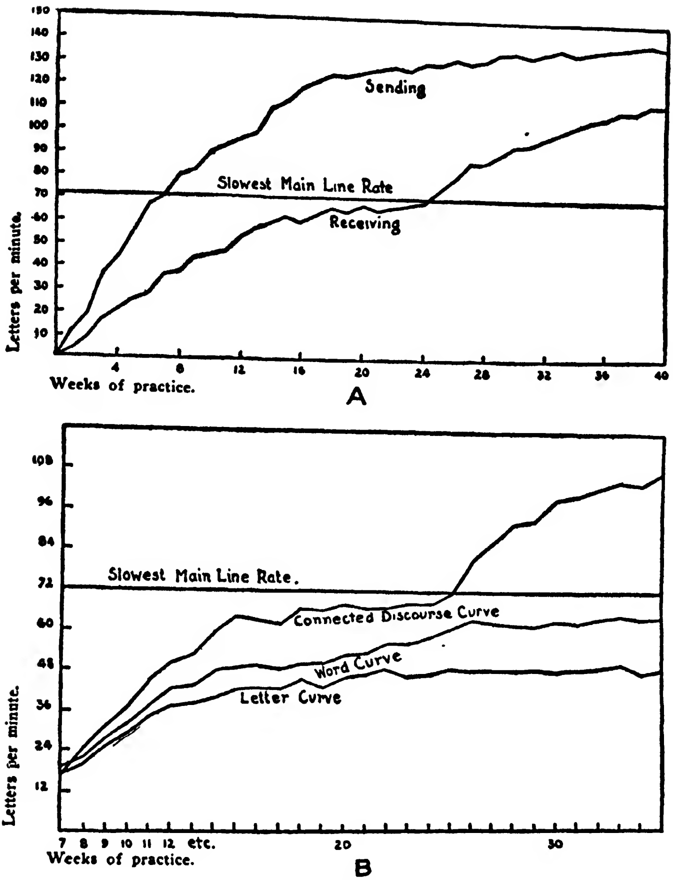


FIGURE 62

THE INTEGRATION OF SIMPLE SKILLS INTO HIGHER UNITS AS ILLUSTRATED BY THE LEARNING OF TELEGRAPHY

A. Learning curves for sending and receiving of one subject during forty weeks of practice.

B. Analysis of plateaus as shown by learning curves for receiving unconnected letters, unconnected words, and connected discourse. The letter curve reaches its upper limit by about the twentieth week and shows no further improvement thereafter. The word curve, however, makes a decided gain after letter skill has been perfected and the curve for connected discourse rises very sharply after the ability to receive unconnected words has reached its limit.

(From W. L. Bryan and N. Harter. "Studies in the Physiology and Psychology of the Telegraphic Language," *Psychol. Rev.*, 1897, 4, 27-53. Courtesy Psychological Review Co.)

of a fairly long period during which little or no improvement takes place, followed by a sudden shift for the better, usually means that the subject has substituted a more efficient for a less efficient method of work. One way of doing this is by organizing small units into larger ones, as Bryan and Harter have shown. But any other fundamental improvement in method, coming after the limits of improvement by the old method have been reached, will bring about a similar change in the curve. A sudden increase in interest and effort, following a long period of discouragement or boredom, may also bring a plateau to an end and send the learning curve upward once more. Children who seem to have made little or no progress in their school work for some time often get a fresh start and learn with fair rapidity after a change to a more sympathetic teacher or one who makes use of methods that arouse their interest. Factory workers whose output, when they were paid by the day, remained at a dead level for months or years have been known to show a surprising spurt in production after a change to the piece-work system.

Maze Learning by Rats, Children, and Adults

A number of years ago Hicks and Carr * undertook to find out how human beings of different ages would compare with rats in ability to learn a maze. They constructed two mazes of similar pattern, one of a size suitable for rats and another much larger one for use with humans. In all, 23 rats; 5 children, ranging in age from 8 to 13 years; and 4 university graduate students learned to run the maze. Because of the differences in size and structure of the subjects, differences in the time required to run the maze would not have much meaning; but the average number of errors made by each subject in each successive trial can be com-

* V. C. Hicks and H. A. Carr, "Human Reactions in a Maze," *J. Animal Behavior*, 1912, 2: 98-125.

pared with more justice, since the mazes were of the same pattern and so the chances for error were the same for all. Figure 63 shows the average number of errors made on each of 17 successive trials by each group of subjects.

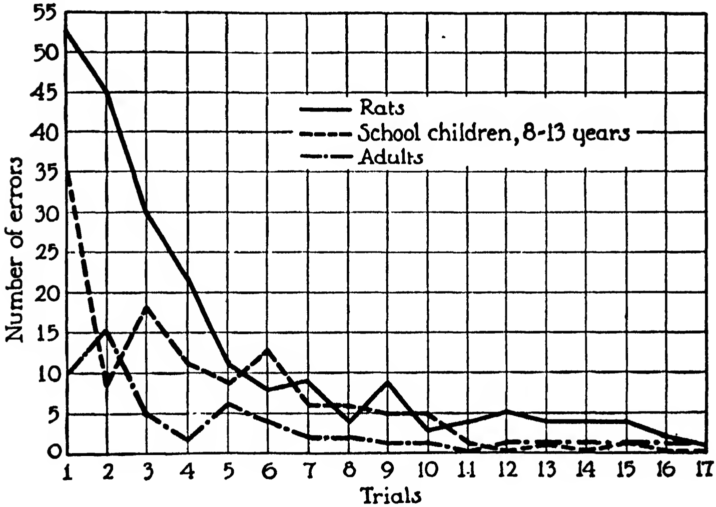


FIGURE 63

COMPARISON OF THE NUMBER OF ERRORS MADE BY RATS, CHILDREN, AND ADULTS IN LEARNING TO RUN A MAZE

(After V. C. Hicks and H. A. Carr, "Human Reactions in a Maze," *J. Animal Behavior*, 1912, 2: 98-125.)

The rats made a great many more errors at the start than either the children or the adults. One reason for this is almost certainly to be found in the fact that they did not know in the beginning why they had been put into the maze nor what they were expected to do there. But the training was always done when the rats were hungry, and because they were hungry they were restless and active. They went exploring as rats will do at such times. They went in and out of the alley-ways, doubling on their tracks many times

and so piling up their "error" scores. Finally by sheer blundering luck they chanced upon the food. The next time they were put into the maze the same sort of performance was gone through, but they did not repeat the same errors so many times, and on the average they reached the food box a little more quickly. The third time they did still better and from then on they continued to improve until on the seventeenth trial the average number of errors had been reduced from 53 to 1.

The children and the adults had this advantage over the rats, that they knew at the start what they were supposed to do and so, although there was nothing to guide them at first in choosing their pathways, they at least were trying to find their way out and so were less likely to wander aimlessly back and forth making the same errors over and over again. This was particularly true with the adults, who were inclined to go slowly and carefully and so made few errors. However, because of their slower movements their saving in time was not as great as one might expect from an examination of the error scores alone. The children were more active and less cautious. If they were in doubt as to whether or not a certain opening led in the right direction, they did not waste time in thinking about it but dashed in to find out. So although they did not make as many errors in the beginning as the rats, they made very many more than the adults. But after the first few trials the differences in the performances of the three groups had become very small and by the end of the experiment there was little to choose among them.

The chief difference in the maze learning of school children and adults is not so much a question of their relative ability to learn as of their manner of attack upon the problem to be learned. The same difference appears in learning other motor skills. The child goes at the thing with more vigor. He makes more mistakes, but he will also get in more

practice in the same length of time. As compared to the child of preschool or kindergarten age, however, another difference can be seen. The school child has reached a level where he is willing, within limits, to keep on trying even under difficulties. He is less likely to give up as soon as the activity begins to lose interest. He can look ahead and think how much fun this thing will be after he has learned how to do it, and the prospect keeps him working long after the younger child would have given up in disgust. He will work at learning a maze for the fun of learning the trick of it, whereas the rat must be motivated by food and the younger child by some special device such as a bell that rings when the goal is reached. And there is another difference. The rat and the young child make the same mistakes again and again. They are lacking in self-criticism. They do not analyze their failures and their successes, and they do not profit very much by being told what is wrong with their methods. But the school child, although he is still inclined to rush ahead and try things out without giving very much thought to how he does it, nevertheless is beginning to pay more attention to method. He learns that there are right ways and wrong ways of doing things, and so he gains in skill not simply by reason of more practice but through practice of a better kind.

That the kind as well as the amount of practice is important is shown by an experiment in tossing rope rings over a wooden post that was carried out by Goodenough and Brian.* In this experiment, three groups of young children were trained by different methods. The first group was given daily practice with incentives but no instruction apart from an initial demonstration. The second group was given verbal instruction and criticism, as for instance, "not quite so far

* F. L. Goodenough and C. R. Brian, "Certain Factors Underlying the Acquisition of Motor Skill by Preschool Children," *J. Exper. Psychol.*, 1929, 12: 127-155.

next time," but the children were not required to keep to any set manner of holding the rings or of bodily posture while throwing them. The third group was taught a definite manner of standing, grasping the ring, starting and completing the act of throwing; and they were not allowed to experiment with any other methods. All three groups were given twenty trials a day for fifty days, and the same incentives were used for all. All the children in the third group showed decided improvement, but the average improvement for the children in the other groups was much less. Several of them failed to gain at all. In the greater number of these cases the failure to gain was found to be the result of setting up a bad habit of some kind which interfered with the performance. For example, some children developed a habit of dropping the ring to a vertical position just as it left the hand. Of course it would then strike upon its edge and roll. Even if well aimed, it would rarely go over the post. Continued practice only made the habit worse as the children were unable to see for themselves what was wrong, and they were not able, apparently, to profit by being told of their error as older children might have done. The better performance of the children who were held to a constant procedure appeared to be due to the fact that they were less likely to set up bad habits in throwing. Practice does not amount to much if it means doing the wrong thing over and over without knowing what is the matter.

The average daily performance of the three groups is shown in Figure 64.

The learning curves for ring throwing show much slower and more irregular gains than those for maze learning. (Compare Figure 63.) The negative acceleration so characteristic of many learning curves does not appear. The curves shown in Figure 64 are typical of the learning of complex acts where success depends upon the organization

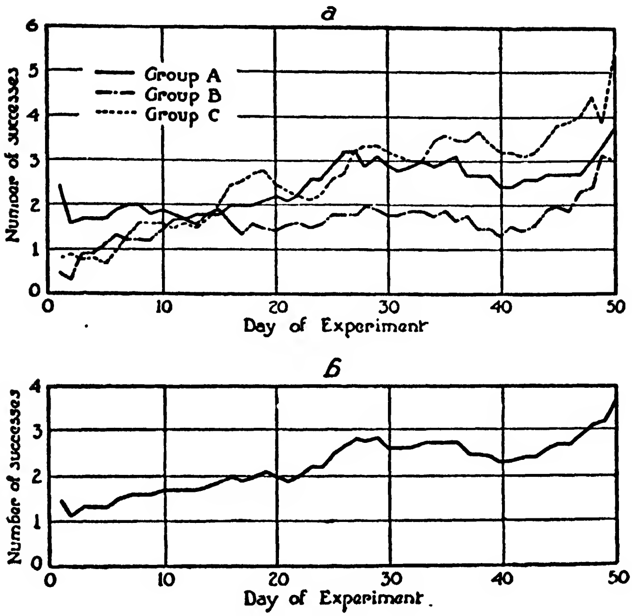


FIGURE 64

EFFECT OF DIFFERENT FORMS OF INSTRUCTION ON LEARNING A RING-TOSS GAME

All groups were given equal amounts of practice. Group A was given no instruction; Group B was given a preliminary demonstration and criticism but was not required to adhere to a prescribed method; Group C was taught a definite procedure at the start and required to adhere to it throughout. The lower curve shows the combined results for the three groups.

(From F. L. Goodenough and C. R. Brian, "Certain Factors Underlying the Acquisition of Motor Skill by Preschool Children." *J. Exper. Psychol.*, 1929, 12: 127-155. Courtesy of Psychological Review Co.)

of many factors into an integrated whole and where failure in a single element disrupts the entire performance.

The reason why maze learning usually shows such rapid improvement as compared to the slow and irregular gains in learning a more complex act of motor skill is the fact that in maze learning there are, as a rule, only two alternatives

possible at any point, and there is immediate check-up as to which of these alternatives is the right one. Moreover, every wrong choice has to be corrected and the right path chosen instead, unless one chooses to lie down and die in the *cul-de-sac* or to keep forever dodging in and out of the same one, which even the most stupid animal is not likely to do. At every turning point in the maze the subject who chooses the wrong path meets with an obstruction, a thwarting of his activity, and this obstacle can only be overcome by turning around and taking the right path. The only alternative is to retrace the path by which he has come. But since the subject has already been over that route, unless he is very stupid or has no idea of any end to be sought, he is not as likely to retrace his steps as he is to go forward. He learns the right path rapidly because he cannot make an error without finding it out, and every error has to be corrected. In the ring-toss experiment just described the situation is very different. At any given point in the performance, the possibility of error is not confined to a simple choice between two alternatives, but has many variations. Failure may come from throwing too far or not far enough, too much to the left or too much to the right, too high or too low. Any of the foregoing errors may be the result of unperceived changes in bodily posture, in arm movements, in hand and wrist movements. Even though the subject sees what kind of a mistake he is making, he cannot always tell what movements are causing it or how to correct it.

In the experiment just cited a little girl noticed that her rings were being pitched too low so that they usually struck the top of the post without going over it. "They don't go high enough," she observed. But her method of correcting the error was to stand on tiptoe, raising the rings as far as she could reach and then throwing them straight downward so that they struck almost at her feet. Every golf

instructor is familiar with such situations. It is not enough for the learner to know the kind of error he is making. What he needs is to get the muscular "feel" of the correct movement, in other words, his ideas of "right" or "wrong" must be linked up with his movements, and not be confined to a visual perception of results when it is too late to do anything about it. In maze learning, where there is only one wrong for every right response, this is comparatively easy, but in learning golf or tennis where there are so many more wrong than right ways of doing the thing, learning is slower and more irregular because the visual perception of the results does not so readily become tied up with the movements by which they are produced.

The Effect of Practice upon Individual Differences

When a number of different persons take part in a learning experiment, they do not all show equal ability at the start. A part of this difference in initial ability may be due to differences in the amount of practice on similar performances before the formal experiment was begun, for it is very hard to select any kind of task that has nothing in common with the activities of everyday life. Differences in performance that are entirely due to unequal amounts of previous practice will tend to disappear in the course of time when all subjects are given the same amount and kind of training.

Even when equal opportunity for learning is given, some subjects learn more easily than others. However, if the task to be learned is so simple that even the poorest learners are able to master it when they are given sufficient time, differences in the performance of good, average, and poor learners tend to disappear as all the subjects approach the *physiological limit,* that is, as all learn to perform the act as rapidly as their bodily mechanism will permit. But if the task is very difficult and particularly if it is one that makes

a great demand upon abstract intelligence, the poorest learners will soon reach a point at which very little further improvement is possible for them, while the best learners will continue to gain. In this case, differences in the performance of the subjects will become greater with increased practice. The effect of increased practice upon the differences in the performance of individuals will therefore depend upon the difficulty of the task to be learned and the amount and kind of previous experience of the subjects. If the initial differences are chiefly due to unequal amounts of incidental practice on similar activities before the experiment was begun, these differences will become smaller when all are given equal amounts of practice in a learning experiment. If the amount of previous incidental practice has been approximately equal for all and the initial differences between the subjects are due to the fact that some have profited by this experience more than others because they learn more easily, the effect of further practice will vary according to the complexity of the task to be learned. In general, when previous experience has been equal for all subjects, with further practice the differences between individuals will be lessened, if the thing to be learned is comparatively simple and concrete. In learning difficult or abstract tasks the initial differences between the subjects are likely to increase rather than decrease with practice.

General Comparisons of Human and Animal Learning and of the Learning of Children and Adults

When we read of the experiments on learning and retention that have been carried out with animals and compare them with the findings from similar studies on human beings of different ages, the point that chiefly impresses us is the amazing similarity of the general principles that have been found to hold good for all groups. Provided the conditions of learning are the same, the laws of learning seem to apply

equally well to animals, children, and adults. But conditions cannot always be made the same. Human beings learn things that animals cannot learn and they learn them by methods that are beyond the power of animals to employ. Likewise, older children and adults learn things that babies cannot learn, and their methods of learning also show certain characteristics that differ from those typical of infancy and early childhood.

Learning by conditioning, that is, by learning to respond to stimuli that formerly produced no response or that produced a response of a different kind, is typical both of animals and of human beings of all levels of development. Conditioning really means changing the meaning of a situation by associating it with some past experience that involved satisfaction or dissatisfaction to the learner. After conditioning has taken place, the subject responds to the new stimulus in much the same manner as he did to the original one. The baby who became conditioned to fear a white rat by having a loud startling sound made whenever the rat was shown to him soon came to show the same signs of fear on seeing the rat alone that he had formerly shown on hearing the noise and seeing the rat simultaneously.

Learning by trial and error is just a special case of learning by conditioning. In ordinary usage, however, we reserve the term *trial and error* for instances of learning in which the subject is actively seeking a goal of some kind, while the term *conditioning* is used to denote those instances in which behavior is modified through conditions that the subject does not attempt to control. In both cases, learning comes about by building new meanings into particular situations. Learning by active trial and error, like the more passively acquired conditioned response is exhibited by animals, children and adults alike, but animals and young children rely on it more extensively and are likely to employ it in situa-

tions where older children or adults would make more use of thinking and reasoning.

Learning by observation and imitation seems to be almost if not quite a uniquely human accomplishment. Even monkeys, who are popularly supposed to be such talented mimics that the expression "imitative as a monkey" has become proverbial, rarely, if ever, learn new tricks or accomplishments merely by having other monkeys go through certain performances in their presence. As far as we have been able to determine, cats, dogs, and the less intelligent animals do not learn by observation at all. One cat may have learned by trial and error how to undo the fastenings of his cage to get food. Another untrained cat is allowed to watch him do this. Over and over again the box is opened and the food secured, while the hungry companion looks on. Finally the new cat is given a turn, but all his watching has helped him not a bit. He has to learn the trick for himself by trial and error methods, just as the first cat did. Only human beings and some of the anthropoid or manlike apes such as the chimpanzee, who are nearest to man in intelligence seem able to improve their own performances by observing others. This failure to learn by observation and imitation is undoubtedly one of the main reasons why animals do not develop a language. Even apes cannot imitate well enough for that.

Although human children begin to imitate very early, their ability to learn by means of imitation increases rapidly as they grow older. Part of this gain with age comes from improvement in motor control, but much more of it comes from better directed observation and attention. Failure to imitate correctly is often due to failure to select the right thing to imitate.

Is learning by imitation then fundamentally different from learning by passive conditioning or by the more active trial and error procedure? Yes and no. Like them its essential

feature is the attachment of a new meaning to a particular situation, but the process by which this change in meaning is brought about is more abstract. In ordinary conditioning or in learning by trial and error the satisfaction or dissatisfaction is produced by the subject's own act, and so the act and the situation from which it arises take on a quality of satisfyingness or unpleasantness by direct association. In learning by observation and imitation, it is somebody else's act that brings the result which is recognized as being satisfactory or the reverse. For this reason, learning by observation and imitation of other people requires a much higher level of intellect than the other forms of learning we have considered.

Whether or not children have a natural tendency to imitate others, whether there is an "instinct of imitation" is a question that has been much debated. In the sense in which the word *instinct* is often used, that is, as a blind and unreasoning set of actions which the subject performs without previous learning when the appropriate situation arises, we may well doubt that such a tendency exists. But the normal child appears to derive a good deal of social satisfaction from being one of a group and doing what the others are doing. This tendency is particularly strong in the child of school age. To the extent that such a tendency exists, learning by imitation may be much more closely allied to learning by conditioning or by trial and error than the last paragraph would indicate. If imitation itself is the goal and the social satisfaction resulting from a successful imitation furnishes the emotional component that changes the meaning, it may well be that what the child learns by imitation is merely a by-product of his learning to imitate. That most children try to imitate others, there can be no doubt.

Let us take a concrete example. A little child is sitting at a table beside his father who is writing. The child picks up a pencil and handles it. In the course of his manipulations

he beats or rubs one end against the table where it happens that a sheet of paper is lying. The father sees this and is much pleased. "He saw me writing and is trying to write, too," he exclaims. The baby is praised and caressed. He is praised when he tries to poke his shoestrings into their holes, laughed at and petted when he holds the newspaper before his face as if reading, coaxed to drink all his milk "just like big brother does." From the beginning, social conformity, "doing what the others do," is urged upon him as the desirable way of behaving. He is praised and rewarded when he imitates successfully, punished or scolded when he insists upon following his own methods. Many of his toys are miniature tools or copies of household implements used by adults and he is encouraged to use them as adults do. When older persons wish to teach him some new accomplishment, the usual method is to "show him how" and again he is praised or rewarded in proportion to his success in imitating their performance. Few aspects of behavior meet with such consistently pleasant social consequences as imitation of others.

The fact that children are able to grasp the abstract idea of imitation, while animals for the most part have to stick to concrete manipulation and trial and error behavior is highly significant. The fact that children do imitate as much as they do is probably more the result of their learning that imitation is likely to meet with social rewards than of any "instinctive tendency" toward imitation as such.

Problem Solving Without Previous Trial and Error Behavior—"Insight"

Human beings and the more intelligent animals do not always resort to pure random experimentation of the trial and error kind when faced with a problem to be solved. Instead they show evidence of what has often been called *insight* (see Chapter X), that is, they react at once to

observed qualities of objects rather than to the objects themselves.

The degree of insight, as one would expect, increases with age. Apes and young children respond only to very simple relationships and to qualities of an obvious kind. Older children and adults make use of more abstract concepts.

Learning by insight does not seem to be essentially different from learning by trial and error except that it works at a higher level. Ideas are manipulated instead of objects; observation and thought replace muscular action. But although some psychologists appear to think of insight as something that comes by itself, a simpler view would regard such behavior as analogous to the building up of the "higher units" or more complex action patterns that we discussed in connection with motor learning. Through concrete experimentation by the trial and error method the child learns to work in terms of certain general principles just as the telegrapher in time learned to work in terms of "word-habits" instead of "letter-habits." These abstract ideas about the qualities of objects have been formed from everyday exploitation of the objects themselves. From repeated trials the child finds that objects having certain qualities—roundness, sharpness, hardness, and so on—can be made to serve purposes that other objects with different qualities will not serve. So in meeting new situations involving objects that he has not seen before, but which nevertheless possess certain familiar attributes, he does not find himself completely at a loss.

Here is a new object. He does not know its name nor its purpose. But he sees that it has sharp edges and so (since earlier experience has shown him that objects with sharp edges can be used for cutting), if he wants to cut something he does not run around trying out everything in sight, but instead he picks out the unknown thing with sharp edges and uses that.

The degree of insight shown by any person depends both upon his level of intelligence and upon the amount and kind of experience he has had in similar situations. Animals below the level of monkeys show little insight because they react to objects and situations as wholes rather than to their separate qualities. But human beings of equal intelligence show varying degrees of insight according to their experience. A skilled mechanic faced with a strange piece of machinery is likely to show much more insight in dealing with it than a lawyer of equal or greater general intelligence who has had little experience with machinery will display. Although the machine as a whole is unfamiliar to both, the mechanic will see in it many familiar principles, the workings of which he understands. But the lawyer is bungling and slow because he has not built up a system of "higher units" that apply to the machine situation. Nevertheless, in dealing with legal quirks and tangles that the mechanic would find hopelessly puzzling, he may display a promptness and efficiency that would be amazing to any one who had previously watched him poking stupidly at the various parts of the machine. Insight is not independent of earlier trial and error behavior but results from it, though in varying degrees according to the intellectual level of the individual concerned.

Chapter XVII

BRIGHT AND DULL SCHOOL CHILDREN

Why is it particularly important to determine a child's intellectual level when he first enters school?
What kind of tests are used with children of school age?
On the average, do children who work rapidly or those who work slowly accomplish the most when unlimited time is given them in an intelligence test?
Into what three grades is it customary to classify the feeble-minded? About how much can be expected in the way of self-help and useful work from persons of each grade if kept in an institution? What are likely to be the social consequence of their remaining outside the institution?
What are some of the ways by which the number of the feeble-minded may be reduced in future generations?
What evidence have we for assuming that the great men and women of the future will be chiefly drawn from the bright children of to-day?

Testing the Intelligence of School Children

Before children enter school, differences in mental ability do not show up very clearly in everyday life unless these differences are very marked. The home has no very definite standards for accomplishment, there are no promotion dates, no report cards, no formal lessons to be mastered in a given length of time. Provided that a given child is healthy, reasonably obedient, and that he learns to do the simple

things expected of him after a fashion, even if he does not learn them as well or as quickly as his cousins, the average parents are not much concerned. "He is only a baby; you can't expect much from him yet," they tell each other. But school life is different. At school the flexible standards of the home are replaced by the definite requirements of the curriculum. Children are expected to learn certain things each year and they are tested as to their knowledge. If they fall short they are likely to fail of promotion. Their shortcomings are no longer glossed over; they stand out for all the world to see.

There are many different causes for school failures. Some children fail because of poor study habits, some because of poor physical condition and consequent irregular attendance, some because of defective hearing or vision. Others fail from lack of interest and effort. But by far the most common cause of school failure is inferior intelligence. In deciding which of the many possible factors is chiefly responsible for the school difficulties of a given child, or in selecting the very bright children who are capable of doing more than the usual amount of school work either through an enriched curriculum or by rapid promotion, intelligence tests are of great help. Tests for children of school age are much more dependable than those in use with younger children. Although they are by no means infallible, nevertheless the results of a good test given to a school child by a competent examiner will in most cases give us a much better idea of his actual ability than can be secured in any other way. Not only do tests given at this age provide us with a pretty reliable measure of his present ability, but they also enable us to predict with a very small margin of error how the child is likely to develop later on. After the age of five or six, however, an entire school class can be tested at one time with fairly dependable results, although individual tests must still be resorted to in doubtful cases

or when any decision of major importance depends upon the result.

Group tests usually include a smaller variety of items than individual tests, and they are in most cases so planned that answers are to be given by underlining or checking the correct replies in order that scoring may be quickly and easily done. The most common type of group test includes from four to ten parts, each part consisting of a number of items of the same general kind arranged in order of difficulty. There is a time limit for each part, and as soon as this time has expired the children are required to start on the next part whether they have finished or not. In some tests the time limits are made so short that only the quickest workers and those who know the material so well that they do not have to spend any time in wondering what the correct answers may be are able to finish. These tests are often called "speed tests." In other tests the time limits are long enough so that practically all children will have time to finish as many of the tasks as they are able to perform. Such tests are known as "power tests." There has been much discussion among psychologists as to whether the speed test or the power test provides the best index of children's abilities. Investigation has usually shown, however, that there is not a great deal of difference in this respect. Although when a speed test is changed into a power test by increasing the time limits most children will be able to answer more questions, they will nevertheless keep about the same position with reference to each other that they held before. That is, the children who know most will on the average work fastest because they have the subject-matter of the tests so well in hand that they need spend much less time in thought. The fable of the tortoise and the hare finds little support in the psychological laboratory.

Extreme Differences in Mental Ability

The Feeble-minded

Some one has said that the Lord must have loved ordinary people, since he made so many of them. At any age we find that the great majority of individuals rank fairly close

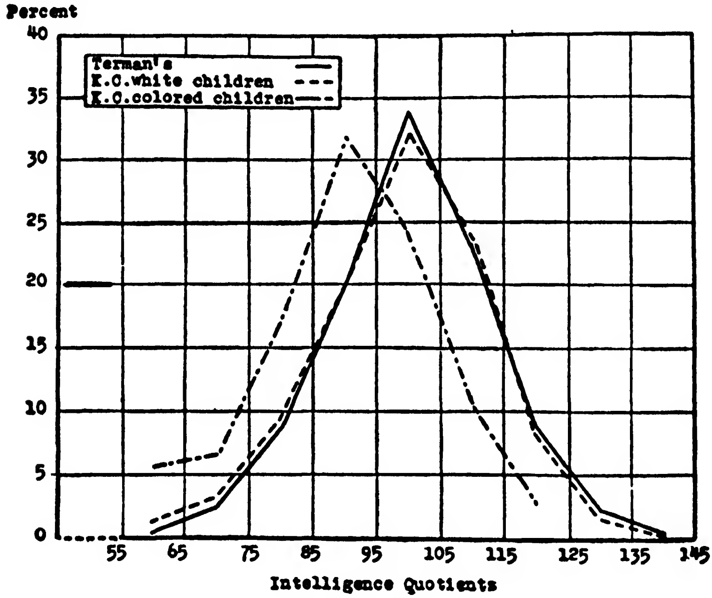


FIGURE 65

DISTRIBUTION OF STANFORD BINET INTELLIGENCE QUOTIENTS FOR KANSAS CITY WHITE AND COLORED CHILDREN COMPARED WITH THAT FOUND BY TERMAN IN THE ORIGINAL STANDARDIZATION OF THE SCALE

(From L. Strachan, "Distribution of Intelligence Quotients of Twenty-Two Thousand Primary School Children," *J. Educ. Res.*, 1926, 14: 169-177. Courtesy of the author.)

to the average in almost any kind of trait or ability we may choose to consider. The further we depart from the average in either direction the fewer the number of persons we find at each successive level of ability. Figure 65 illus-

trates this. It shows the distribution of intelligence quotients of 6,063 white children and 375 colored children in the primary grades of the Kansas City public schools. The distribution of IQ's found by Terman for the 905 children upon whom the scale was originally standardized are included for comparison.

Most of the children in both groups cluster around the average, that is, their IQ's are between 90 and 110. But at each end there are a few who differ greatly from the general run of children in mental ability. At the lower end of the distribution are 254 white children and 47 colored children or 4.7 per cent of the total number whose intelligence quotients are below 76. Some of these children belong to the large class of "not very bright" persons who nevertheless manage to get along in the world after a fashion. As children they learn slowly and usually fail of promotion every now and then, but in time they may be able to finish the elementary school and to earn a living afterward in some simple occupation. However, many of the group shown here are truly feeble-minded. They are not idiots, for idiots, as we shall see presently, are not likely to get into the public schools. Most feeble-minded school children belong to the group known as *morons*. Roughly speaking, morons include those persons whose IQ's during childhood fall somewhere within the range of 50-70 and whose mental status as adults is roughly comparable to that of normal children seven to eleven years old. Of course one cannot take this classification too literally for, as was pointed out in Chapter XIV, the IQ is an approximate rather than an exact measure and may shift up and down within a range of several points on repeated tests. Moreover in practical life it is impossible to draw a completely hard and fast line between those who are to be classed as "normal" and those who are classed as subnormal or mentally defective on the basis of abstract intelligence alone, even if we had a perfect measure of it.

Whenever we approach the boundary between normality and feeble-mindedness we find that differences in such traits as persistence, docility, and effort, are likely to turn the scale in one direction or the other where there is doubt. Really this boundary is not a line but a zone within which some persons whose mental backwardness is accompanied by lack of self-control, indolence, obstinacy, and similar traits, preventing the best use of such abilities as they possess, are likely to be classed as feeble-minded, while others of no greater mental capacity but with more stable personalities are able to function as normal persons in situations that do not demand very much in the way of abstract thinking.

Often the feeble-minded child in the public schools is not recognized as such unless he rebels and becomes an active behavior problem, perhaps through sheer boredom at being continually required to toil away at tasks that he cannot perform and does not understand. His misbehavior is not the direct result of his mental backwardness but is due to the fact that he has been forced into a situation where he does not fit. As he grows older, matters are likely to become steadily worse. Through repeated non-promotions he lags further and further behind the children of his own age until the discrepancy in size between him and the other children in his class becomes acutely embarrassing. The emotional discomfort leads to further misbehavior and so the trouble grows. Nevertheless, if placed in a good institution or even in a special class for backward children and given work that he is capable of doing, the trouble-maker of the grades may be transformed within a few months into a docile, happy child. His mental capacity is not likely to improve, but his behavior may be greatly modified by suitable treatment. If he is set at tasks that are not too difficult, he may even show considerable progress in learning. The school child of moron grade is not completely uneducable but the progress he is capable of making is distinctly limited, particularly

when it comes to books. If given plenty of help and allowed to go slowly, he may be able to master the work of the first four or five grades by the age of fifteen or sixteen, but he is not likely to be able to go much further than this. In manual work he may do somewhat better, though usually not as well as the child of normal ability.

When placed in an institution, morons learn to do all kinds of routine work about the buildings and grounds. Some even learn such complicated tasks as type-setting. One of our best-known institutions for the feeble-minded has for years published a small psychological journal which is set up and printed entirely by the boys and girls of high-grade moron level.

A step further down the scale of mentality we find the *imbeciles*. A few of the higher grade imbeciles, those close to the morons in ability, sometimes get into the schools, but most of them are sent to special schools or to institutions. Generally speaking the imbecile group embraces persons whose IQ's run from 20 to 50 and who as adults reach a mental level comparable to that of normal children aged from three to six or seven years. In institutions, imbeciles learn to perform a good many simple tasks such as cleaning floors and woodwork, running a lawn-mower, sweeping and dusting. With books they make little or no progress.

The mental development of imbeciles proceeds at so slow a rate that they are usually recognized for what they are long before it is time for them to enter school. Morons also develop slowly but the difference between them and normal children is less marked and so their real inability is often mistaken for laziness, naughtiness, or obstinacy. Intelligence tests are particularly useful here in giving a more exact idea of how much can fairly be expected from each child.

At the very bottom of the intelligence scale are found a small group of persons known as *idiots*. Idiots comprise the class whose intelligence quotients do not exceed 20 and whose

final mental status never surpasses that of a normal child of two or three years. Idiots rarely learn to say more than a few words; some never speak at all. The lowest grades do not even learn to walk or to feed themselves and even the simplest of institution tasks are as a rule beyond their capacity to learn.

The following brief descriptions * of actual cases will give a more concrete idea of the different levels of mental defectiveness:

"Nora. Present age 25 years. Mentality 1 year.

On entering the institution at the age of 9 years she could not yet walk or talk. Sixteen years later at the age of 25 she had learned to walk but could not talk. She is very restless and excitable, eats garbage or anything that comes to hand, cannot use a spoon and must be fed like a baby. She has never learned either bladder or bowel control."

"Izzy. Present age 12 years. Mentality 2 years.

Izzy does not talk nor dress or undress himself, but can understand a few simple commands. He is usually cheerful, plays a little, but is quarrelsome and restless. He is affectionate, likes to look nice as, for example, with a new suit of clothes. He listens for the dinner bell and then walks over to his dinner in evident anticipation; he can carry a bowl of soup to the boys at the table but his attention is so poor that he cannot be kept at one thing long enough to be of any use."

The next case would be classified as a high-grade imbecile, ranking very close to the moron level. Cases such as this sometimes get into the public schools.

"Bennie. Age 14. Mentality 6.

On entering the institution at the age of 7 years, Bennie walked with uncertain gait, was very excitable, laughed without cause, often strayed from home. He was obstinate but affectionate and was fond of playing with the other children. The following year it was reported that he im-

* These accounts are abbreviated reports taken from H. H. Goddard, *Feeblemindedness; Its Causes and Consequences* (New York: The Macmillan Company, 1914).

proved steadily under instruction but this improvement did not continue long. At the age of 14 he is still in the kindergarten as he seems to fit better there than anywhere else. He can do practically nothing in book work, very little in tasks requiring much dexterity of hand such as basketry or hammered brass. He seems to try but makes little progress. He cannot copy either a square or a diamond and when asked to write his name can make nothing but scribbles. He can name the primary colors but cannot count as many as 13 pennies. He is full of mischief and always getting into trouble; is a great talker but his speech is thick and indistinct. He is cheerful, quarrelsome, stubborn, quick-tempered and destructive."

The last of our feeble-minded cases (quoted with minor changes) is typical of the fairly high-grade moron. The public schools contain many children of this type and because of their normal appearance and the fact that they make some progress in book work their real state of mental deficiency often remains unrecognized.

"Mary. Present age 19. Mentality 9.

When admitted at the age of 6, Mary seemed only a little backward. She understood language and commands, was obedient, could wash dishes and do errands and was fond of playing with her dolls. She improved steadily. By the age of 7½ she had learned all the first kindergarten work, could count to 39, add combinations to 10 and copy easy sentences. She was interested in her work and tried to do it well. But she soon reached her limit in book work. She has never been able to learn to read beyond the second or third grade level. She now knows two or three multiplication tables and can add a little. In industrial work she has steadily improved until she is now one of the best girls in the cottage. She is neat, careful, and can do almost any kind of work."

Goddard * comments on this case as follows:

"This girl is a striking example of the type of woman who, out in the world, becomes quickly victimized because

* *Op. cit.*

of her quiet unresisting manner. Pretty and attractive, she holds the attention of the passerby, is easily captured by the designing rascal and may even attract a man of more intelligence."

What will be the future of these children and of the thousands of others like them who are denied the kindly protection of an institution and forced into a losing battle with the outside world? We know from having followed thousands of cases that feeble-minded children become feeble-minded adults. No method of physical treatment or of education has yet been discovered that will do much to improve their real mental capacity. Proper training in an environment that does not demand more from them than they are able to give may enable some of them to become partially self-supporting under supervision and will prevent their becoming an active menace to society, though they will always remain a burden upon it. When left unsupervised to look out for themselves in competition with normal persons, only by unusual luck will they be able to get along without falling into extreme distress and poverty, if not worse. Many become the dupes of unscrupulous persons who take advantage of their simplicity and make use of them for their own ends. The girls drift into prostitution, the boys into crime.

Bad as this is, it is not the end. If left to themselves, many of these children as they grow older will themselves become parents either in marriage or outside it. And because mental traits are no more exempt from the laws of heredity than physical traits, the children are likely to resemble their parents in mentality—or the lack of it—just as they resemble them in bodily characteristics. That the great majority of mental defectives owe their condition to inheritance has been amply demonstrated. Some cases, of course, are due to other factors—to birth injury, to accidents or disease in early life, or to disorders of the ductless glands.

But an overwhelming majority of the feeble-minded of the present generation came from feeble-minded stock, and the ranks of the next generation of feeble-minded will be replenished from the same source.

What can be done? One very obvious possibility lies in seeing to it that no feeble-minded person is allowed to bear offspring. This method of improving the race will obviously take time, for human generations come a long way apart, and the genes making for mental deficiency are unwittingly carried by many normal persons who have themselves escaped the defect because of the protective effect of normal companion genes provided through other lines of their ancestry. (See pp. 47-48.) They, as well as the feeble-minded proper may transmit the defective strain to their children. Nevertheless, if hereditary feeble-mindedness is ever to be greatly reduced, some measure of this kind seems necessary. Just how long it would take to get completely rid of such a defective strain by this means is uncertain because we do not know enough about the details of its transmission. We do not know, for example, whether a single pair of genes is involved in the production of the most common forms of mental defect or whether, as seems more likely, several pairs act in combination. If the latter is the case, we do not know how these pairs are distributed in the various chromosomes—that is we do not know what linkages should prevail. (See pp. 43-44.) And while we do know that selective mating, i.e., mating between persons of similar intellectual state rather than between normal and feeble-minded at random is the rule, yet exceptions occur often enough to scatter the defective genes pretty widely throughout the general population, particularly when we remember that family stock which is entirely free from genes making for mental defect is constantly being contaminated by intermarriage with persons who, without being aware of it, carry the defective genes.

Even though the decrease in hereditary mental deficiency that would result from preventing all feeble-minded persons from having children is small, any gain whatever is worth while in controlling a problem that has such grave social consequences as this. Biometricians who have attempted to estimate how great the gain would be give somewhat different figures, but on one point all reputable scientists seem to be agreed; that is, that the great gain would come in the first generation after such measures were put into effect because this would stop the increase that comes from persons having two defective genes. After the first generation the reduction would continue but at a very much slower rate.

This is not all. Although scientists do not always agree as to the relative effect of hereditary and environmental factors in determining what a given child's mentality shall be—some being more hopeful than others as to the possibilities of bringing about improvement through training—we must not forget that under present social conditions most children are reared by their own parents and so heredity and environment are likely to work together. It is unlikely that a feeble-minded mother will give her children the kind of care and training that will enable them to make the best use of whatever small abilities they may have; it is equally unlikely that a feeble-minded father will be able to provide his family with the physical necessities of life, since his earning capacity is small at best and his ability to plan how his small income (if he has one) can be most effectively used is still smaller.

The Opposite Extreme—Children of Superior Ability

This is a rather doleful picture. Let us turn to something more cheerful. If you will look back at Figure 65 you will notice that the backward and feeble-minded children who stand at the extreme left of the distribution are not the only ones who differ greatly from the average. Their numbers

are about balanced by other groups of exceptionally bright children who fill the ranks at the right. Some of these children stand as far above the average as the feeble-minded are below it; an occasional child may even exceed the average as greatly as the idiot falls short of it.

What a contrast there is between even the best of the feeble-minded group and the brilliant youngsters who occupy the corresponding positions at the other end of the intelligence scale! The following case reported by Terman * is an example. In comparing this child with the feeble-minded cases just described, remember that we are now looking at a seven-year-old, while the feeble-minded "children" ranged in age from twelve to twenty-five years.

"D.B. Age 7 years, 5 mo. Mental age, 13 years, 7 months. I.Q. 183.

D. learned to walk at 9 months, talked at about a year. Played with anagrams when a baby and learned to read as gradually and naturally as he learned to talk. At the age of three years without his parents knowing he could do it he picked up a new book suitable for children of nine years and read it through intelligently. Now at the age of seven he dresses and undresses without help, bathes and cleans his teeth by himself. Plays ball, bats, and skates. Handles "mechano" models requiring deft fingers. Typewrites rapidly, using only two fingers on each hand. Taught himself printing and typewriting. Reads very rapidly. Leaves his books willingly to play but goes back to them when play is over. Has read a great deal of Shakespeare with particular liking for the historical plays. (*Pericles* is his favorite.) Has read every history book in the house, including Gibbon and Grote. Plays many games with cards, a baseball game and a question game, various kinds of solitaire, chess. Spends hours over his toy train tracks. Once calculated how long it would take his little train to run a mile at the rate it went around his track, measuring in the center of the track, he explained, 'to be sure to get

* L. M. Terman, *The Intelligence of School Children* (Boston: Houghton Mifflin, 1919).

the exact answer.' Formal arithmetic was begun when he was seven years old by spending about an hour a week on it. He also spends about an hour each week on algebra and about the same amount of time on geometry with his father as teacher. He has no difficulty with either subject."

Some people have the idea that very bright children are likely to be physically weak or socially "queer." This idea probably arose in part from the mental mechanism known in psychology as "rationalization," by which people try to console themselves for failure to do or be what they would like. Rationalization often takes the form of inventing plausible excuses for failure and so avoiding damage to self-esteem by convincing oneself that the failure was justified. Another common form of rationalization is that described in the fable of the fox and the grapes. We try to convince ourselves that after all the thing we wanted has something wrong with it that makes it not worth having. So it is natural enough for people whose own children are not remarkable in any way to look askance at such young geniuses as D.B. and to feel that somehow or other such great mental precocity must be compensated for by a lack in some other direction. Then, too, it is extremely hard to remember that a child whose mentality and interests are on a level with those of children who are so much older than himself is after all only seven or eight or ten as the case may be. We expect his body to be as advanced as his mind.

Terman * has made a study of nearly a thousand exceptionally bright children in California, all of whom were as far above the average in mental ability as the feeble-minded are below it. He found no basis whatever for the popular notion that bright children are likely to be sickly or

* L. M. Terman et al., *Genetic Studies of Genius*, Vol. I, *Mental and Physical Traits of a Thousand Gifted Children* (Stanford University: Stanford University Press, 1925).

emotionally unstable or unable to get on well with their playmates. Bright children are not all alike any more than other children are, and in any large group of them some will be found who are small for their age, some who are not in robust health, some who are unpopular. But these are the exceptions. Not only in the California group of bright children but in a number of smaller groups studied by other investigators it has been found that children who rank much above the average in intelligence are a little more likely than children in general to show other desirable traits as well. On the whole they have slightly better health and physical development, are more than ordinarily popular with their playmates, more likely to be leaders, and have better than average emotional control. This may be due in part to better training, for just as feeble-minded parents are likely to bear feeble-minded children and to care for them poorly afterward, so exceptionally able parents are likely to have bright children and to give them superior care. Probably, too, the child of superior mental ability finds it a little easier to adjust to the world around him because he understands it better.

What will be the future of such an exceptional child as D.B., or of the thousand bright children studied by Terman, or of the many others like them who are growing up all over the country? This question has already been answered in part by following the later progress of the bright children first studied in early childhood. Many of them are now in college; some are already entering upon a professional career. So far, with few exceptions their early promise is being well fulfilled. Let us turn again to a few individual cases.

D.B. was first studied in 1917. The account given on pp. 405-406 is based upon the report made at that time. Eleven years later, in 1928 he was looked up again. This is his later history.

"D.B. entered junior high school at the age of 9 years and senior high school at 10. He graduated from high school at 12 years and won a scholarship to an Eastern university. At 16 he graduated from college with honors and after transferring to another university he registered as a graduate student in the physical sciences. At the end of his first graduate year he was awarded a fellowship. He plans to make research his life work."

D. has never taken much interest in social affairs and has few acquaintances, though he is well liked by those who know him, and all recognize his ability. With respect to his social characteristics Terman * comments as follows:

"D. is not and never has been maladjusted in the ordinary sense of that term; he is merely inclined to be solitary. The indications are that he will develop into a man without eccentricity other than the retiring disposition that often characterizes scientists and scholars."

But not all bright children prefer solitude to companionship. Here is the later history of one of the children in the California study.

Henry learned to read at the age of four and composed his first story at five. He entered school at eight, starting in the fourth grade. He was given his first test that year and was found to have an IQ of 157. Six years later, at the age of fourteen, his intelligence rating had not changed; he was in the third year of high school and planning to become a lawyer after finishing college. From the beginning he has not only been a "straight A" pupil but has been more than ordinarily popular with the other children. At the age of eleven he was chosen Boy Mayor of one of the largest cities in California and served for a week. In spite of all the publicity given him at this time he has remained unspoiled and free from conceit. He is physically active, fond of outdoor sports, and a decided leader among his companions.†

* *Genetic Studies of Genius,* Vol. III, p. 268.

† Adapted from case reported in *Genetic Studies of Genius,* Vol. III, pp. 257-259.

Doubting Thomases may still ask whether these cases are anything more than examples of childish precociousness maintained into early youth. No one can say as yet what these individual children will later accomplish, but it is possible to look at the question from another angle. What were the great men of history like as children?

Cox * attempted to answer this question. She collected all the biographical information she could find about the childhood of three hundred of the world's intellectual and social leaders—great scientists, writers, artists, musicians, reformers, statesmen. On the basis of this collected information, four psychologists who had had a great deal of experience in giving intelligence tests to children and were well acquainted with what the average child is able to do at different ages estimated what the IQ's of these men would most likely have been had they been tested in childhood. The estimates for the different men varied a good deal, partly because so little was known about the early development of some of them that there was little to go by in making the judgment. But almost without exception the estimates were high. The following is a much abridged account of the early development of Thomas Macaulay whose IQ is estimated at 180.

Even in his infancy his mother recognized his precocious powers but far from rejoicing she was distressed for she thought her boy was marked for an early death. At three, young Thomas read incessantly and his memory retained without effort the exact phraseology of the book. At four, when a servant had spilled hot coffee over his legs, he replied to a solicitous inquiry, "Thank you, madam, the agony is abated." On another occasion when the maid threw away the oyster shells which served as a fence for his garden plot he said, "Cursed be Sally; for it is written, 'Cursed is he that removeth his neighbor's land mark!' "

* Catherine M. Cox, *Genetic Studies of Genius*, Vol. II, *Early Mental Traits of Three Hundred Geniuses* (Stanford University: Stanford University Press).

Before the age of seven Thomas wrote a compendium of universal history which his mother described as "a tolerably connected view of the leading events from the Creation to the present time, filling about a quire of paper." Before he was eight he wrote a paper containing a very clear idea of the doctrines of Christianity with some arguments for its adoption, for Henry Daby to translate into Malabar in order that it might serve to convert the natives of Travancore to Christianity. At the age of seven or eight he wrote a heroic poem, "Olans the Great, or the Conquest of Mona" after the manner of Virgil, introducing in prophetic song the future fortunes of his own family.

He is described as "a good tempered boy, always occupied and without assumption."

In reading the childhood stories of these famous men and women one is more and more impressed, on the one hand by the great similarity between their early development and behavior and that of the children whom we now classify as "extremely bright" and on the other hand by the equally great contrast between them and present-day backward or mentally defective children. We cannot expect that all the bright children of to-day will live up to their early promise for many things may happen to prevent their doing so. Early lack of opportunity, poor training, lack of intellectual stimulation, or the development of emotional reactions that hamper expression—any or all may play a part. Nevertheless, even though some may fail, the likelihood is very great that the intellectual and social leaders of to-morrow will be recruited from those who show superior rather than inferior abilities as children.

Chapter XVIII

SPECIAL ABILITIES AND DEFECTS *

What is a special ability? Cite some examples from your own experience.

What are some of the factors that cause children to be poor readers?

What kind of special abilities can be most accurately measured in grade school children? What are some of the other special abilities shown at this age for which our present testing methods are less accurate?

What is meant by eidetic imagery? How does the eidetic image differ from the after-image? From the memory image? About what proportion of children under twelve show eidetic imagery? Do adults also show it? What effect has eidetic imagery upon children's learning?

What is meant by imagery types? Are highly specialized imagery types more or less common among children than was formerly supposed?

What are some of the most common kinds of speech defect and how may they be caused?

What is meant by the beta hypothesis of learning, and by whom was it proposed? To what practical uses has this theory been put?

Examples of Special Abilities Shown in Childhood

Terman † reports the case of a child, examined by him at the age of two years, who could read fluently from any

* Special disabilities due to a physical defect such as total or partial blindness or deafness have not been considered in this chapter.

† L. M. Terman, "An Experiment in Infant Education," *J. Appl. Psychol.*, 1918, 2: 218-229.

primer. This is an extraordinary feat even for a child of high intelligence. Her IQ was found to be 150, that is, she had at this time a mental age of about three years but her reading was easily as good as that of the average child of seven. It is interesting to note that, although after she entered school she did exceptionally good work along all lines and had several extra promotions, reading and literature continued to be her strongest subjects. This is probably explained by her early start.

From babyhood this child (Martha) was subjected to a very rigorous course of training in reading by her father, who was interested in finding out at how early an age children can be taught to read. It is impossible to say whether or not her exceptional accomplishment is the result of a natural talent for reading over and above that which one might expect on the basis of her high intelligence. Perhaps any child of her general ability might do equally well if given the same training. Heredity probably accounts in the main for her general intellectual level, for she comes of an able family. Her older brother is even more brilliant than she is, though he was not given the same kind of intensive coaching in reading and shows little if any greater ability along that line than along any other. Like his little sister he made an exceptionally good school record. Perhaps if Martha had been given the same kind of intensive coaching in number work as in reading she might have shown an equally astounding performance in that line, but as to this we can only speculate.

The early history of Mozart as reported by Cox * affords an even more striking example of special talent combined with unusually high general ability. The judges who read the account of Mozart's childhood estimated his IQ at 150. Some of the chief indications of his early musical talent are quoted below.

* *Op. cit.*

"From before his sixth year Mozart's sole absorbing interest was in music, and even the games he played had some musical element. . . . When he was between three and four he was taught by his father to play the clavier; he learned minuets and other pieces which he soon played 'with perfect correctness' and in exact time. At the age of seven he began to receive instruction in singing by an Italian master and at fourteen he was studying and executing the most difficult counterpoint.

"At the age of five Mozart first felt the impulse to produce and the little pieces he composed were written down by his father. Three works are recorded before the age of six; a Minuet and Trio for Clavier (Op. 1), a Minuet (Op. 2) and an Allegro (Op. 3). . . . When he was seven his first published work appeared, four sonatas for piano and violin, one of which showed especially remarkable taste. Between the ages of seven and fifteen he composed works for pianoforte and violin, pianoforte concertos, masses and church music, 18 symphonies, 2 operettas, and at the age of fourteen an opera. When he was twelve his first operetta was performed. At thirteen he received an appointment as grand ducal concert master (without salary) and in his first year of office he composed 20 numbers. At the age of fourteen his first Italian opera was presented with great success.

"At seven his extraordinary sense of absolute pitch was discovered as well as his remarkable skill with the violin and the organ which he had never been taught. . . . Locked up for a week by an incredulous archbishop and required to prove his ability by writing an oratorio without outside aid, Mozart (age eleven) achieved a brilliant triumph, a mature musical composition though written with blotted notes in a childish hand."

Although here, as in Martha's case, we have early talent fostered by special training, there is greater evidence for a special and inborn musical gift not entirely accounted for by general ability alone. Mozart came of a musical family, though none of the others achieved great renown. It is specifically stated that his early training was begun because the boy showed special musical interest and aptitude. His

sense of absolute pitch and his ability to develop skill with instruments never formally taught him, provide further evidence that his musical talent was largely inborn.

Mozart, in common with most other great musical composers, was almost certainly possessed of high general intelligence as well. It is doubtful whether special musical talent that is not accompanied by high intelligence will ever enable one to achieve outstanding success as a composer. The musicians studied by Cox were all rated very high in intelligence.

A point that seems to distinguish musicians from the other great men of history is the very early age at which not only their general ability but their special musical genius is shown. In a large percentage of the men who achieved fame in fields other than music, one would be quite at a loss, from the study of their childhood performances and interests, to predict what they would become as adults. The evidence for their exceptional general ability is clear, but special aptitudes for the particular field in which they later achieved renown do not show up so early. Perhaps the fact that musical ability is by its very nature somewhat specialized and conspicuous makes it easier to recognize in childhood. Other special abilities may appear just as early but may escape recognition because we do not know what signs to look for. Whatever the reason, the fact remains that most, if not all, of our great composers have shown both high general intelligence and unmistakable signs of marked musical talent at an early age.

Musical talent without high general intelligence may also exist but in these cases the persons are not likely to become composers but musical performers of more or less merit.

Occasionally persons with decided musical talent are found even among the feeble-minded. One of the best known cases of this kind is that of "Blind Tom." Blind from birth, an imbecile who could never be taught to care for himself

physically, Blind Tom had a remarkable gift for music. He could play almost any musical composition after one or two hearings, and for years was a well-known performer on the vaudeville stage. Blind Tom was not a great musician like Mozart or Beethoven. He composed nothing and it is said that his ability was so purely of the reproductive type that if, when something was played for him to imitate, the player purposely struck a false note and then corrected himself, Tom would strike the same note and make the same correction.

It is only rarely that special talent as remarkable as that of Blind Tom and a few others like him is found among the feeble-minded. These very rare persons in whom special talent greater than that possessed by the average person of normal mentality is combined with genuine mental deficiency in all other fields are sometimes called *"idiots savants"* (wise idiots). Here is another case, not quite so remarkable, perhaps, yet, had Peter lived to grow up,* it is not impossible that, like Tom, he might have become something of a stage celebrity under the right management.

Peter was a little epileptic boy of Italian parentage whose home was in a slum and who had spent most of his short life in the streets. When I first became acquainted with him he was nine years old and his IQ was about 40.

Peter was a talented mimic. Although he had never had any training, his ability to imitate the voice, manner, gait, even the facial expression of any person or animal he had ever seen was little short of remarkable. One of his most realistic performances was an imitation of a cat fight. Each of the two warring cats had his own individual voice, his own manner, his own "personality," one might say, and Peter impersonated each in turn, never forgetting to change his position with the change in personality. The battle began with a series of low, throaty growls, wary sidesteppings, short advances, and sudden retreats. As it rose to a climax, there came the long caterwaulings, interspersed with sudden

* He died at the age of fifteen.

sharp hisses and frantic yowls, as one side or the other scored an advantage. Presently human voices added to the uproar, often, I grieve to say, with language not approved by polite society, and a moment later Peter, seizing a broom or some other convenient weapon became transformed into an irate human being and brought the fight to a dramatic conclusion by chasing his two yowling selves into the next street.

Peter also had a gift for making up amusing little stories and plays, which he acted out as he told them. The following sample was taken down verbatim.

"One-a-day was a drunk man. Drunk! He go down the street singing and hollering." [Illustrates.] "Bime-by he take out a bottle out his pocket. Whiskey! He drink it an' bing! Fall in the ditch! 'Ow, Ow, Ow!' he holler. 'I broke my leg, I broke my leg.' The 'lance [ambulance] come 'long." [Sound of siren and bell.] "'Lance-man hear him holler. He stop. Look all around. Look in the ditch. He say, 'Hey, what the matter, you?' Drunk man say, 'Oh, I broke my leg, I broke my leg.' 'Lance-man say, 'Well come on then, I take you to the hospital.' Drunk man say, 'No, no, I no go. I no want to go to the hospital.' 'Lance-man say, 'Come on,' 'No' he say." [At this point Peter grasps his leg in both hands and gives a dramatic representation of the "drunk man" trying to escape from the ambulance driver. But the latter is too much for him and to the tune of frantic howls the victim is captured, put into the ambulance, and driven to the hospital. There the doctor comes and after examining his leg decides that it will have to be cut off. Cries and tears are of no avail. The doctor repeats that the leg must come off. He gets his saw—"a big saw!" But just as the fatal deed is about to be started, help arrives.]

"Drunk man's dog come along. He stop by the window. He smell—like this" [Sniffs]. "He smell the drunk man. He jump! Quick! In the window! He grab the doctor's coat in the back. Doctor scare. He say, 'Ow, Ow, Let go me!' He run! Drunk man jump up. He hold his leg and he run. Out the door. Out the hospital. Home."

Both Blind Tom and Peter showed a degree of ability in their special lines that would be remarkable even in a nor-

mal person. It is true that they are unusual cases. However, feeble-minded children, in common with the normal and the gifted, almost always possess special abilities in the sense that they can do some kinds of things better than they can do others. Compared with normal children their little accomplishments may not amount to much. But compared with their own general level of performance they may be very remarkable indeed.

Arthur is an imbecile boy who did not enter school until he was more than ten years old. Then a special class for low-grade feeble-minded children was organized in which he was enrolled. His mental age at that time was not quite three years and his IQ about 25, which puts him very close to the idiot group. Bladder control was only partly established; he walked with a shambling gait, bending forward from the hips and swinging his arms to keep his balance. He could do very little with his hands. If given a piece of chalk, he would make a few big scribbles on the blackboard, holding the chalk in his fist without opposing the thumb. He could not be taught to cut with scissors or to hammer nails in a board or to use a saw.

But unlike most feeble-minded children whose retardation in language is usually greater than their motor handicap, Arthur talked almost constantly, and although his articulation was thick and slovenly he could easily be understood. And he was intensely interested in stories. To be sure the stories had to be simple, but to such tales as "The Little Red Hen" or "Jack and the Beanstalk" he would listen with absorbed attention as long as any one could be found who would tell them to him. This, too, is unusual in children of such low mentality.

Because he was so greatly retarded it was not thought worth while at first to try to teach him to read. But one day, when the teacher was giving a word drill by means of "flash cards" * to some of the more advanced children, she happened to glance at the corner where Arthur sat. There on the edge of his chair, all agog with excitement, hands

* Flash cards are large cards on which the words to be learned are printed in type of a size that can be seen across the room.

on knees, body swaying backward and forward as each new card was shown, he was pronouncing the words along with the other children. The amazed teacher tried him out by himself and found that he could recognize and name quite a number of words without hesitation. From then on he was given a short lesson in reading each day and in three years time, that is by the age of thirteen, he had learned to read easy stories well enough to give him much pleasure. To be sure his reading ability never exceeded that which an ordinary child accomplishes by the end of the second grade. If compared with the performance of the average boy of thirteen his reading would seem poor enough. But in comparison with what he could do along other lines, it was extraordinary. He never learned to count as many as four pennies though he could repeat the numbers from memory up to a hundred. His concept of number in the concrete was limited to "one" which he always named correctly and "more than one" which he called by any number that happened to come into his mind at the moment. He learned after long effort to make a single stroke on the blackboard when told to write the figure "1" but that was the extent of his writing. He made practically no improvement in handwork of any kind. But he learned to recite a number of simple poems and the words of several songs. He could keep to the tune pretty well in singing with the other children but not by himself.

For a child who is as feeble-minded as this boy, learning to read at all is extremely rare. In its way the case is probably quite as unique as that of little Martha who learned to read at two, and we may note in passing that the mental ages of the two children were about the same. In Arthur's case, however, the contrast between his reading ability and his general ability—or lack of it—is greater then is true for Martha. The fact that this ability showed itself in a number of different ways—in his speech, which was decidedly more advanced than that of most children of his mental level, in his intense interest in stories, in his ability to memorize poems and songs—all of which have to do with language,

points strongly to the idea of a natural "talent" of some kind. This talent, it is true, was stunted and distorted by its association with an imbecilic mentality. But it is remarkable enough, for all that.

Special Abilities Are Shown at All Levels of General Intelligence

We can see from these cases that special abilities are not confined to the gifted few. Any one, no matter what his level of ability, may possess them. Indeed, if we define special abilities in the way that is most useful in the practical guidance of children, everybody not only may but does have such abilities, perhaps not very great ones, but at least they are his own individual "specialties," the things he can do better than anything else. It is important to compare children with each other in order that we may know which are the most promising. But it is equally important—perhaps even more so from the standpoint of helping the individual—to find out along what particular lines each child excels and what are his chief weaknesses. With the help of such knowledge, training can be more wisely planned.

The Measurement of Special Abilities and Defects in Childhood

There is one large group of special abilities that can be measured at any given time with a good deal of exactness—the abilities in the various subjects of the school curriculum. There are excellent tests for measuring how well a given child can read, spell, or do arithmetic, and for testing his information about history, geography, science. The results of such a series of tests can be plotted so as to show at a glance in what subjects he is weakest and in which ones he excels. Age and school grade can, if desired, be plotted on the same sheet making it possible to see in what subjects he does better than the average child of his age or of his

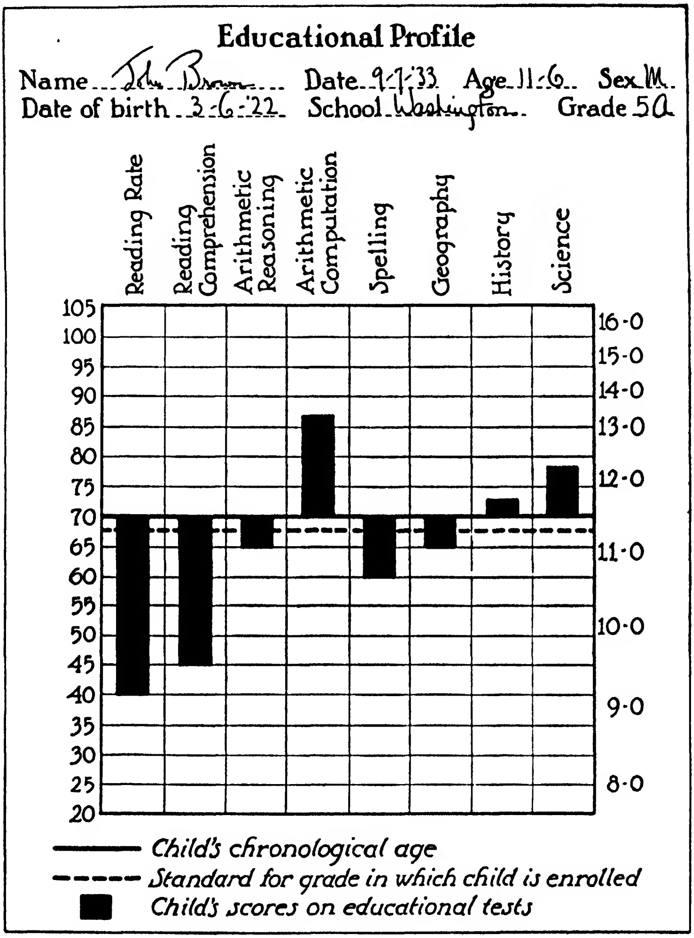


FIGURE 66

EDUCATIONAL PROFILE OF POOR READER

school grade and in what ones he falls below either of these standards. Charts such as these are often called *educational profiles*. An example is given above.

As his educational profile shows, this boy has a good deal of difficulty with reading. Now a child who is a poor reader is bound to have a lot of difficulty with his other school subjects as well, and since the further he goes in school the more he is expected to learn by reading, the greater, consequently, will his handicap become. Because a deficiency in reading has such serious and widespread consequences for the child's whole educational future, reading defects have been much studied and a good many different theories have been built up about what causes some children to read so much more poorly than their general intelligence warrants. One difficulty with many of these theories is that they try to find one general explanation that will account for all poor readers while as a matter of fact some children read badly from one cause, others from other causes.

Almost certainly the most commonly correct explanation of poor reading in children of good intelligence is to be found in the early setting up of bad reading habits. Perhaps the child has failed to organize the small units (words, syllables, phrases) into larger units and so he reads slowly, haltingly. Or perhaps he has not learned to see the small units at all; he may have been taught so entirely by the "word method" or the "sentence method" that he has never learned to pick out the smaller elements for re-combination. Then when he meets a new word or a new sentence he is helpless. Sometimes confusion results when a child starts to learn to read by one method and then changes to another school where a different method is taught. But no matter what kind of bad reading habit he has formed, so long as it is a bad one that interferes with his learning to read, the result is bound to be the same. Reading to him will seem "hard" and unpleasant and so he will spend just as little time as possible in doing it. On the other hand, the child who is a good reader very soon reaches a point where reading is done for its own sake as a form of recreation. As a

ing is later in developing than musical ability, it may not be very profitable to study it before the adolescent period. Many children like to draw and do very well at it for a time, but this childish interest does not seem to be very highly predictive of later artistic performance. Although most famous musicians showed unmistakable signs of talent before the age of ten, the biographies of great artists rarely describe any marked indications of special artistic gifts that were shown before the child was in his teens.*

Other special talents, such as mechanical ability, may and probably do show themselves with more or less clearness before the age of twelve, but, as the tests for measuring them are planned for use with older children in connection with immediate educational and vocational guidance, we shall reserve their discussion for a later chapter.

Memory Images and Imagery Types

Many people, when they recall a past experience, are able to bring certain parts of it to mind so clearly and vividly that the event almost seems to be lived through again. Not quite, because there is no actual confusion between the recalled experience and the real experience of the moment. But the memory image is so clear that even the sensations experienced at the time seem to be actually felt once more.

As I sit here at my desk, a bit of my childhood suddenly comes before my mind. For one fleeting instant the familiar walls with their rows of books vanish and in their place I see a low gray stone wall with blue sky above it and at its side the trunk of the apple tree under which I am lying. I feel the rough stubble of the grass beneath my head and I smell the earthy fragrance of the ground under the hot sun. Above me a bird is singing.

* Compare the biographical sketches in Champlin's *Dictionary of Painters and Paintings* with those in his *Dictionary of Music and Musicians* for evidence on this point.

Both grown people and children differ a great deal in the clearness with which experiences of this kind can be recalled. But images of a peculiarly vivid and detailed kind, so vivid indeed that they seem to be actually seen, as if they were projected upon a kind of invisible screen, are especially common among children before the age of puberty. These images are known as *eidetic images* and the persons who have the ability to see them are called *eidetic individuals*. Eidetic imagery varies greatly in degree even among children, and in many children, as in most adults, such images do not seem to exist at all. Just the ability to recall a past experience is not eidetic imagery. The picture must be actually "seen." The strongly eidetic person can often describe with minute accuracy even the minor details of a complicated picture or object after only a brief exposure. As he does so he can be seen to move his eyes as he "looks" at one part of his image after another. In experiments on eidetic imagery a screen of a neutral gray color at which the subject can look is often placed a short distance before his eyes. On it the objects with which he is to be tested are placed. When the objects are removed, the image is seen as if it were still on the screen. Strongly eidetic persons may even move the screen back and forth as they would a book or picture "in order to get a better look." All this seems to show that the eidetic images are really "seen" and not just remembered in the ordinary sense.

The eidetic image also differs from the "after-image," which was described in an earlier chapter. After-images do not change except to grow fainter and disappear, and they do not reappear after an interval unless the stimulus is renewed. But eidetic images do both. Parts that are faint can often be made to grow clearer by "looking" at them attentively. They may seem to grow larger or smaller; they may even seem to move about. And eidetic images may often be recalled after a considerable interval, when they reappear

almost, if not quite, in their original clearness. They are thus more subject to control than after-images.

The significance of eidetic imagery for education during childhood is not entirely understood, but there is little doubt that children who possess this ability make a good deal of use of it in their learning.* Some report that they can "see" the words in their spelling lesson if they look at the wall of the room and that they copy the lesson from this eidetic image. Other lessons may be "read" in the same way when the recitation period arrives. Children who are less strongly eidetic cannot depend as much on such images and the images themselves are often incomplete and sometimes inaccurate in their details, but even weak eidetic images are of some help in learning.

Just why, after adolescence has been reached, most people lose the powers of eidetic imagery that they possessed as children is not known. In a few cases the ability persists throughout life, but these cases are rare.

Eidetic imagery has been chiefly studied in the visual field, but there is reason to believe that other types exist. Auditory eidetic images have been reported and it is thought that olfactory, kinesthetic, and other sensory types may exist.

Some years ago the question of imagery types was much debated, particularly in regard to the education of children. It was thought that for every one there was some particular sensory field in which memory images were so strong and vivid that he would be able to learn much more readily through that particular sensory avenue than through any other. There was the visually minded child who must be taught everything by means of sight, the auditory minded one who must learn through his ears, and the kinesethetic

* It has been estimated that at least half of all children under thirteen or fourteen have some degree of eidetic imagery. However not all of them are equally gifted in this respect.

or motor-minded child who must learn through his muscles. This theory has been pretty well exploded by modern investigation except for a very few extreme cases. Provided that all the senses are in good working order, few children or adults make exclusive use of any one kind of memory image. With most people visual imagery is likely to be clearest and most often used, but other types of memory images also exist. The relative strength of the different sensory modes in a recalled experience is likely to follow about the same pattern as that of the original experience. If the original was predominantly auditory, the memory image will also emphasize the auditory factor. If an imaginary experience instead of an actual one is in question, the character of the imagined event will largely determine the type of imagery used. If it has to do with a conversation between other people, the image will be chiefly auditory, though the people may also be visualized in the act of talking. If the person himself takes part in the conversation, a kinesthetic element is added. As a matter of fact, it is probable that most people's mental images, whether of recalled or imaginary events, are likely to embrace a large number of sensory fields at the same time.

Speech Defects

At least one school child in a hundred is distinctly handicapped by imperfect speech. If we include minor as well as major defects, the number is much greater. Most defective speech is probably due, in the main, to environmental conditions, though defects in the organs of speech such as tongue-tiedness, hare-lip, or badly formed teeth and jaws are sometimes responsible. Probably, too, there is a constitutional factor involved in a good many cases, especially in stuttering. Children in whom this hereditary factor exists are likely to form habits of stuttering under conditions that would not affect those whose nervous organization is more

stable. Imitation also plays an important part in speech defects of all kinds. Children whose parents speak with a marked foreign accent usually speak with a similar accent when they first enter school, but even without special training this accent may be gradually lost through association with other children. People from various parts of the United States have their own peculiarities of pronunciation and accent. A student in a mid-Western university was heard to refer to one of her instructors, a New England woman with a decided New England accent, as "that foreign lady." Even stuttering sometimes gets its start by imitation of other persons who stutter. One stuttering child in a classroom may start a little epidemic of stuttering.

Speech defects are of many kinds and have been classified in many different ways. Roughly speaking, however, they fall into two broad groups, stuttering or stammering (including complete or partial blocking of speech) and the various kinds of articulatory defects such as lisping, substitution of one letter sound for another as in baby-talk, indistinct or slovenly speech, foreign accents, bad voice placement, and so on. As a rule, defects of the second type are much easier to correct than stuttering.

There are many different theories as to the cause of stuttering. The cerebral dominance theory has already been discussed. (See pp. 262-263.) In fairness it should be said that there are many speech clinics in which stuttering is treated by having patients who show signs of having been originally left-handed, but who have learned to use the right hand, go back to using the left. In some of these cases the amount of stuttering is decreased, but how much of this improvement is due to the change in handedness and how much to the force of suggestion is uncertain. Apparently in a certain number of cases almost any form of treatment that will really convince the stutterer that he is going to be helped will bring about improvement, and this very fact may

account for the numerous and sometimes rather bizarre "cures" that have been reported.

Stuttering may result from too much attention to the mechanisms of speech. Slight cases of stuttering are often made worse by the well-meant attempts of parents and teachers to correct the difficulty by telling the child to "talk slowly and carefully," or to "watch his speech." Since stuttering is primarily a nervous defect, it may owe its beginning in an excitable child to almost any kind of undue strain, shock, or even an intense fright. Anxiety, worry, and overexcitement in children who have a tendency to stutter are all likely to make the speech worse. For this reason one of the important things in the treatment of stuttering is to make sure that the child is getting plenty of rest, fresh air, and nourishing food, and that he is protected from frights, anxieties, and worries of all kinds. Many, though not all stutterers are below par physically.

Habit Breaking. Dunlap's Beta Hypothesis

A novel method for correcting bad habits of various kinds, including stuttering, has recently been proposed by Dunlap.* Because this method is said to be useful not only in the correction of stuttering but for undesirable habits in general it is worth mentioning in some detail. Briefly it involves the idea of bringing bad habits under control by practising them voluntarily under certain specified conditions.

The idea first came to Dunlap in connection with a persistent and annoying habit he had formed in typewriting. When he wanted to write the word *the* he would write *hte*. Correcting the error each time seemed to have little effect. Finally in exasperation he took a sheet of paper and wrote over and over again, *hte, hte, hte,* each time saying to him-

* Knight Dunlap, *Habits; Their Making and Unmaking* (New York: Liveright. 1932).

self, "This is wrong, I will *not* write it this way again." The amazing result was that he had no further trouble with this particular error. Practising the bad habit *with the intent to stop it* had broken the habit.

Surprised and decidedly puzzled, Dunlap decided to give the method a further trial. He applied it to other habitual errors in typewriting both in himself and in others. It continued to work. He applied it to thumb-sucking in children. Instead of trying to prevent them from sucking their thumbs, children * who were chronic thumb-suckers were *required* to suck their thumbs for definite periods of time each day, whether they wanted to do so or not. And here, too, the method seemed to work. Nail-biting was also successfully treated in the same way.

He applied it to stuttering. Persons who stuttered involuntarily were required to stutter intentionally, under the guidance and instruction of a psychologist. In order that the method may be effective the stutterer must understand in advance that he is learning how to stutter in order that he may avoid stuttering. He is told that if he can learn how to stutter when he wants to, he will not have to stutter when he doesn't want to. So he is given daily practice in imitating his own particular habits of stuttering until he has the mechanics of it pretty well mastered. Then, and not until then, he may begin to try to say, without stuttering, the phrases that have been giving him trouble. Throughout the whole training period he must agree not to pay any attention to his stuttering on ordinary occasions; he must stop trying not to stutter and his family and friends must agree to ignore his stuttering. So far a number of stutterers have been treated by this method and nearly all have shown improvement.

* Dunlap is careful to state that this method is not likely to succeed with children who are less than four or five years old and that care must be taken to keep the child's attention centered on the act of thumb-sucking. He must not be allowed to lapse into day-dreaming.

To this theory that by practising an act one may learn how *not* to do it, Dunlap has given the name of the *beta hypothesis of learning*. At first thought and in comparison with the conventional idea that practice teaches one how to do a thing (the usual or alpha hypothesis) the beta hypothesis seems as improbable as it is unorthodox. But let us see if this is really the case.

There is nothing new in the idea that punishment for an act will decrease the likelihood that the act will be repeated. Now to make a child suck his thumb when he doesn't especially want to do so—particularly if he is not allowed to sink into the relaxed dreamy state that usually accompanies thumb-sucking but is made to sit up and give his full attention to the job—is not likely to afford him much satisfaction and may amount to a very real and particularly ingenious type of punishment. Ingenious, since in the ordinary situation the punishment is something that is tacked on to the act by more or less artificial means and some kind of conditioning process has to be depended on to make the punishment effective, while the application of the beta hypothesis converts the act itself into a punishment or at least into something that is no longer pleasant. On that basis it ought to work, and apparently it does.

In the case of stuttering the mechanism is not quite so obvious, but there are a number of well-known factors that probably play a part. The first factor is suggestion, which, as Dunlap points out, must be given in a convincing fashion at the outset. The patient must believe that the method is going to help him. Another factor is the breaking up of the automatic side of the act of stuttering by giving attention to its separate parts. The habitual stutterer behaves much as you do when you hear or remember the first few notes of a familiar musical phrase. Once the phrase starts running in your mind you cannot help but complete it. But if you turn your attention to the separate notes, or to the way you

are moving your lips, or to any one of the many details that usually take care of themselves automatically, the melody is lost and you no longer feel the need to complete it. Just so, the stutterer who starts to use or even to think of a word on which he has formed the habit of stuttering cannot help himself. The stuttering pattern has to run itself out. But when persistent attention is given to its parts, the stuttering pattern, like the musical phrase, ceases to exist as a unified whole that must be carried through to the end.

There is still a third point. Stuttering, as we have pointed out, always involves a strong emotional factor. The stutterer is embarrassed and disturbed by his stuttering. Now emotions have this peculiar characteristic, that they will not stand close examination. If, in the midst of an emotional experience, you stop and try to make a cold-blooded analysis of your feelings, the first thing you know the emotion is no longer there. An intellectual interest has taken its place. If Dunlap's subjects really took the matter of "learning to stutter" seriously, as we are safe in assuming that they did, and if they became genuinely interested in seeing how well they could stutter when they tried, a good deal of the emotional tension which plays such an important part in inducing and intensifying the stuttering would be likely to disappear.

Although the beta hypothesis may not involve any fundamentally new principles of learning, it does provide a new method of attack upon the correction of undesirable habits both in children and adults. Obviously the idea must be applied with caution, for much further experimentation is needed before we can be sure just how and in what cases it is likely to work. In unskilful hands it may lead to highly unfortunate results.

The Significance of Special Abilities and Defects for the Education and Training of Children

After one has obtained a fair idea as to what a child's abilities and weaknesses may be, what use can be made of the knowledge? Three courses are open: We may ignore the whole matter and follow the same educational régime that we would have followed in any case. We may devote our attention to his deficiencies and let his special abilities take care of themselves. Or we may follow the opposite plan and try to make the most of his special capacities whatever they may be. Accepting the fact that no one can be a master of all trades, we then try to give the child the best possible opportunity to excel in the one for which by nature and inclination he seems to be best fitted.

Neither of the last two plans should be carried out blindly. Some kinds of special deficiencies, such as reading defects or speech defects, have such widespread consequences for a child's whole future that they must, if possible, be remedied no matter what other subjects may be neglected. But to spend too much time harping on a child's weak points, neglecting the lines along which he is capable of excelling, is likely to be both wasteful and ineffective. It is more fun to win than to be always struggling to keep up, and the child who is forced into the latter position by over-emphasis upon his weak points and under-emphasis upon his special talents is likely to lose ground for no other reason than lack of interest. The educational scheme made famous by the twelve Miss Pettigrews who

> ". . . were always taught
> To do the thing they didn't like, which means the thing they ought"

has not much to recommend it.

Chapter XIX

THE DEVELOPMENT OF PERSONALITY AND CHARACTER IN LATER CHILDHOOD

What do we mean by personality? How do we judge it in others? Why is the study of child personality important?

Are such traits as deceitfulness, service, or self-control likely to be shown to about the same degree on all occasions, e.g., is a deceitful person always or nearly always deceitful?

Why are we likely to think that people behave more consistently than the actual facts show?

What may be learned about the personalities of individual children by observing their play?

What is meant by the "time-sampling" method and how is it used in the study of personality? What are some of the other methods by which personality is studied?

How do children's wishes often reveal their difficulties?

What bearing has the principle of "overlearning" (see p. 366) on the relationship between child behavior and adult behavior? In what other ways do the general laws of learning apply to the development of personality and character traits?

What kind of personality difficulties in children are most likely to be overlooked by parents and teachers? Why?

How can personality be improved?

What Do We Mean by Personality?

The term, *personality* is one that we all use very frequently in describing others and to each of us it has a very real meaning. But the meaning somehow contrives to elude analysis.

> I do not like thee, Dr. Fell,
> The reason why I cannot tell

runs the old nursery rime. Dr. Fell, we may suppose had not a pleasing personality, but the factors that made it unpleasant were not easy to pick out.

There are at least two reasons why personality is hard to define. One of these reasons is indicated in the first line of the above rime. Personality is recognized or identified, not so much by the immediate qualities of the individual himself as we stop to observe them but rather by the kind of impression he makes upon us. This is evident from the very terms we are likely to use when asked to describe some one's personality. We say that it is pleasing, magnetic, forceful, charming, or unpleasant, repulsive, annoying. All these terms refer primarily to the way the person in question affects us and leave us in the dark as to what there is about him that produces the effect. In trying to describe the personality of somebody else we are continually hampered by the necessity of referring back to him the feelings, attitudes, and emotions that he arouses in us.

A second difficulty is to be found in the fact that when we attempt to analyze personality into smaller elements we lose the very thing that gives it its essential character. For personality is not a simple trait nor a lot of simple traits added together. It is more nearly like a harmony, a melody, a pattern. Simply enumerating the separate notes that go to make up a melody does not give us the melody itself; describing a pattern as made up of so many spots, so many

lines, so much white space does not give us its design. Personality, like melody, pattern, or design is made up of many simpler qualities combined into a new whole that is a good deal more than the sum of its parts. So if we wish to get some kind of measure of the total personality of any individual, whether child or adult, we shall be most successful if we observe how other people react to him. Instead of taking Johnnie off into a corner by himself and trying to pick him to pieces to see what his personality is made of, we shall do better to find out how Mary and Katie and Susie and Tommie and Peter and Joe behave toward him, what they think of him, how well they like him. And because Johnnie is important to himself as well as to others, we may follow something of the same procedure with him. By observing his behavior and by questioning him after winning his confidence we may be able to learn how well Johnnie likes himself, whether he is satisfied with his own characteristics and accomplishments, how he regards other people, how he thinks they regard him, and whether he is happy or unhappy. In this way we get some idea of Johnnie's total personality. The picture is not very clear; it does not have the numerical compactness of an IQ and it does not fit well into a table of statistics. Nevertheless, if we have carried out our investigation faithfully, we have found out what we need to know. For if Johnnie himself is happy, if he is reasonably satisfied with himself without being conceited, if he likes other people and they like him and seek his companionship, we say he has a good personality, and the more universally these things are true of him the higher we should rate him on a personality scale. But if he is unhappy, unsure of himself, thinks the world is against him, or if he is shunned and disliked by his companions, then we say with equal confidence that there is something wrong with his personality, and it becomes our task to find out where the trouble lies and what can be done about it.

Personality Traits

Strictly speaking, personality is made up of all the factors that make the individual what he is, the complex pattern of characteristics that distinguishes him from the rest of the world. But because this is so vague a concept we try to give it more exact meaning by attempting to analyze out from this total complex that *is* the personality some of the qualities of the individual that strike us most forcibly when we observe him. Then, when we are asked to give a detailed description of some one's "personality," we mention these striking qualities in the hope that by putting them together it will be possible to get a more detailed idea of what his personality is like. Such a picture is always and of necessity incomplete, and it is often inaccurate, particularly when it comes to those parts of the description that have to do with the person's actions. Features, coloring, even bodily size, remain fairly constant over long intervals, but behavior changes from moment to moment. Nevertheless some such method of analysis seems necessary in trying to convey our ideas of personality to other people or even in making them clear to ourselves.

This is not all. Personality to be sure, is much more than the sum of its parts. Nevertheless it is made up of parts and sometimes a displeasing total effect can be traced to one or more single factors that disrupt the whole, just as a single discordant or misplaced note can ruin a melody. Then, if we can find out not only what is wrong but what caused it to go wrong, it is sometimes possible to straighten out the kinks and change a disagreeable personality into a pleasant one. So when we find that a child's personality is not all that we should like it to be, if we find that he is unhappy, worried, anxious, unpopular with his playmates, the first step in correction is to look into his behavior and attitudes a little more closely and try to find out what particular

features in his conduct seem to be making the difficulty or what kind of worries and anxieties are causing his unhappiness. These more specific characteristics are often called *personality traits*. Kindness, coöperativeness, honesty, frankness, seclusiveness, neatness, originality, perseverance, resourcefulness, optimism, timidity, bashfulness, are examples of personality traits.

Not very many years ago it was generally supposed that traits such as these are rather stable qualities in the individual, that, for example, an honest person is honest in nearly all situations; that a resourceful person will show his resourcefulness under almost any circumstances, that a persistent person can be depended upon to stick to almost any kind of task, and that an optimist goes about whistling in all weathers. But recent investigation does not bear out this idea. It is true that both grown people and children show a good deal of consistency in their conduct from one time to another, if the situation remains about the same. Because we so often observe persons repeatedly under similar conditions we become impressed with this consistency and assume that they will behave in just the same way under all circumstances. The teacher who sees Jimmie and Johnnie only in the classroom and finds that Jimmie seizes every opportunity to copy his lessons from his neighbor while Johnnie's eyes never wander from his own paper no matter how many chances for cheating are given him concludes, not unnaturally, that Jimmie is a wretched little cheat and Johnnie is the soul of honesty. If questioned about their "personality traits" she will almost surely rate Johnnie high and Jimmie low on all aspects of honesty and trustworthiness. But she fails to take account of the fact that Johnnie has little need to cheat for he is at the head of his class anyway and doesn't have to worry about promotion. Moreover it would be silly for him to copy from his neighbor when the chances are that his own answer is the right one.

The situation for Jimmie is very different. He is on the verge of failure, and his father has promised him a "good licking" if he doesn't bring home a better report card next time. The two boys differ in classroom conduct, to be sure, for Jimmie cheats and Johnnie doesn't. And there is a real difference in "personality" besides, for Jimmie feels the need to cheat and Johnnie doesn't. But are we safe in assuming that Johnnie is consistently honest and Jimmie dishonest?

Let us follow them out to the playground. Now Jimmie, who is shaky on the multiplication table, who mixes up all the dates in his history lesson, and who spells sugar with an *h* is a "crackerjack" when it comes to marbles, but Johnnie is all thumbs. If an opportunity for cheating comes will it be Jimmie or Johnnie who yields to the temptation?

A few years ago Hartshorne and May * undertook to find out what the chances are that a child who is dishonest in one situation will also be dishonest in others, or, in other words, how consistently the same kind of character or personality traits will show up in all kinds of surroundings and conditions. So they invented a large number of "tests" of deceit. In all there were thirty-two different kinds. The tests were given to more than 8,000 children from all ranks of society. Some of the tests were given to children as home work, some in their school classrooms, some at parties. Some of them were made to seem like school lessons; others took the form of games. But the tests were all alike in that an opportunity for cheating or dishonesty of some kind was always given, and, although care was taken to keep the children from finding it out, some special device was always provided for finding out which children cheated and how much they cheated.

For example, the children were given an arithmetic test similar to those they were used to having in school but too

* H. Hartshorne and M. A. May, *Studies in Deceit* (New York: Macmillan, 1928).

long and hard for any of them to finish within the time allowed. When the time was up the papers were collected and taken away and a duplicate of each was prepared by a clerk. At a later time the papers were given back together with an answer sheet and each child was told to score his own. Plenty of opportunity was allowed for changing the answers or for adding to the amount done. Afterward, by comparing the corrected papers with the copies of the originals the amount of cheating done by each child could be determined.

In other tests, athletic stunts such as measuring the strength of grip on a dynamometer (see Figure 2) or chinning a bar were used, and opportunity was given for faking a record. Others consisted of games that could easily be won by cheating, such as pinning the tail on a donkey or seeing who could carry the most beans from one box to another in a given length of time by taking only one bean at a time. Cheating in this case consisted of taking more than one bean. Tests that provided opportunity for stealing small sums of money with which the children were provided for use in working out problems in making change and which was supposed to be returned at the end of the lesson were also tried out. So also were tests of lying either to avoid disapproval or to secure approval.

When the same tests were tried twice on different occasions, but with other conditions remaining the same, it was found that the children behaved very similarly from one trial to another. Children who cheated at lessons the first time were likely to do it the second time; those who were honest the first time were honest the second time. There were some exceptions, of course, but the general tendency toward consistency was fairly marked. Likewise those who cheated on athletic contests or who lied to secure approval behaved about the same way on repeated trials. But when the performances of the same children in different situations

were compared, the results were very different. There was little, if any, greater likelihood that the child who consistently cheated in the classroom type of situation would fake an athletic record, or cheat in games, or steal money than that the one who was honest in classroom work would do so. Children who cheated on their home work did not necessarily cheat at school. Lying and stealing showed only a small tendency to go together. All in all, the results of these experiments seem to show that conduct is decidedly specific, depending in each case upon the particular child and the particular situation.

The same specificity of behavior was found when other so-called "traits" were studied in a variety of situations. Generosity was found to vary with the thing about which one is called upon to be generous. Some people are generous with their time, others with their money. Most of us find it quite easy to share the things we care little about. Hartshorne, May and Maller * found that the children whom they studied were no more consistent in the kind of things they were willing to do for others than in the kind of situations under which they would be dishonest. This is not strange. Consider the following situation:

Each child was given a pencil box containing ten articles, a drinking cup, a pencil sharpener, a ruler, an eraser, a pen, a penholder, a double pencil, and three ordinary pencils. Then it was suggested that each one might give away a part of his kit to help make up kits for poor children who had none. They were scored according to the number and kind of articles they were willing to give away.

Suppose, however, that Peter's father had been out of work for two years and no one in the family had a cent to spend for anything beyond the barest necessities. For months Peter had longed for one of these pencil kits, but

* H. Hartshorne, M. A. May and J. B. Maller, *Studies in Service and Self-Control* (New York: Macmillan, 1929).

there seemed to be no chance of his getting one. Across the aisle from Peter sat Billy, who was an only child of parents in comfortable financial circumstances, and who had a number of devoted aunts and uncles besides. The day before the kits were given out, Billy had had a birthday and received no less than four kits of this kind, most of them of better quality than the one he had just been given. If Billy gave away all the articles in the new kit and Peter refused to part with any, can we be sure that Billy is the more generous of the two?

The point is that the same external situation becomes a very different psychological situation for different children. It varies with their interests, their abilities, their past experience. It means one thing to this child, quite a different thing to that one, and each child responds in terms of his own individual set of meanings.

As a result of their investigations, Hartshorne and May come to the decision that there are no such things as honest or dishonest children, there are only honest and dishonest acts; no such traits as coöperativeness, service, self-control, and the like but only people who at times act coöperatively, at times perform services for others, and at times exhibit self-control. This of course is true. Just as we pointed out before in discussing intelligence (p. 294), terms such as these have no reference to anything existing in the person but are merely descriptive terms that we use in classifying his acts. But in the case of intelligence we find that some persons act intelligently so much of the time and in so many different kinds of situations and under such difficult circumstances that they really seem to *be* different from other persons. So we transfer the description from the acts to the individual and instead of saying, "This person acts intelligently" we say, "This is an intelligent person." But if intelligent behavior showed no internal consistency, if the person who acts intelligently in one situation were no more

likely than another to act intelligently when the situation is changed, or if the one who acts intelligently to-day were to behave like a moron to-morrow, then to say that this or that person is intelligent would have no meaning.

But have the personality traits we have just been considering no real existence, in the sense of representing consistent behavior tendencies in a given person? Have we no basis at all for classifying certain children as untruthful, dishonest, or quarrelsome, and others as truthful, honest, or even-tempered? Is it true that, if we were able to get an exact and complete record of all the actions of a given group of children over a period of months, we should find that in each case honesty in one direction is so paralleled by dishonesty in another that the differences iron out in the total and all the children turn out to be equally honest?

Both common sense and everyday observation tell us that this is very unlikely. But the differences among children that such a study would almost certainly show can be traced at least in part to differences in the situations in which the children are placed. Some children lie to escape punishment. Others do not. But some children are punished severely for small faults, while others, who are subjected to a more kindly discipline, can be truthful at smaller cost. Some children learn petty thievery and other misdemeanors because they live in neighborhoods where such acts are looked upon as clever. In a study of juvenile delinquency in Chicago, Shaw * found that certain sections of the city produce such a high percentage of all the juvenile delinquents that they may properly be regarded as "delinquency areas." The social situation for children living within these areas is so different from that in which children living in other parts of the city are reared that we cannot be surprised if their behavior also differs from that of children in general.

* C. R. Shaw, *Delinquency Areas* (Chicago: University of Chicago Press, 1929), xxi + 214.

Personality traits—that is, characteristic modes of behavior which appear so often in the course of our association with some particular person that we grow to expect him to behave in that way and to think of him in terms of these behavior patterns, e.g., as being calm, frank, friendly, brusque, or coöperative—owe much of their apparent consistency to broad factors in the general environment which remain fairly constant for a given person but which vary from one person to another. Residing in a delinquency area or in a superior district, belonging to a family that is looked up to in the community or to one that is despised and avoided, being indulged and petted at home or made to conform to strict rules, being an only child with few playmates or one of a large family in a neighborhood with many children are examples of such factors. Because, in the vast majority of cases, the associations of one person with another are likely to take place under a very limited range of conditions, their personalities seem to each other to be much more clear-cut and free from inconsistencies than they would appear after a broader acquaintance. Mary's teacher, mother, playmates, all have very definite ideas as to what Mary's personality is like, but if they were to compare their impressions they might be quite amazed at the difference. The records of the divorce courts bear eloquent testimony to the way opinions of the personality of others may change on more extensive acquaintance.

Because of all these complicating factors the study of personality becomes extremely difficult, and the analysis of "personality traits" must be limited to the particular situations and conditions under which they are shown. To say that a child is afraid of dogs is not only more accurate in a scientific sense but is much more useful in giving us a practical understanding of his personality than to say that he is timid and fearful, for he may be courageous enough under other circumstances. If we know not only that he is

sometimes fearful but under what circumstances the fear is shown we are in a better position to find out what caused it and how to correct it. To say that Johnnie cheats in his school work gives us an inkling as to where we must look for the cause of his behavior, but merely to say that he is dishonest is of little help. To know that Peter will play only with boys who are much younger than himself is more enlightening than to say that he has no friends of his own age. Personality and character traits have a very real existence, but they exist in a moving and changing world and must be defined with reference to the world in which they are shown.

Play as an Index to Personality Traits

There are few aspects of the child's life in which his whole personality is expressed so clearly as in his play. By watching children of different ages at play, by questioning them about the games they enjoy and comparing their preferences with those of other children of their age we can learn much about their interests.

One of the most complete studies of play behavior in childhood that has appeared was carried out by Lehman and Witty.* They prepared a list of 200 games and other amusements (such as looking at the funny sheet, stringing beads, going visiting) and then had more than 20,000 school children from various cities, towns, and rural districts check all those that they had engaged in during the past week. The results were tabulated to show which games were most often played by children of each age, which games were best liked by boys and which by girls, and so on. They found that the greatest number of different activities are reported by the children between the ages of eight and ten years. After the age of ten the number becomes steadily less

* H. C. Lehman and P. A. Witty, *The Psychology of Play Activities* (New York: Barnes, 1927).

each year. The reason for this appears to be that the younger children, in addition to playing their own childish games, also try to imitate the play of the older children. The boys, on the average, report a few more activities than the girls.

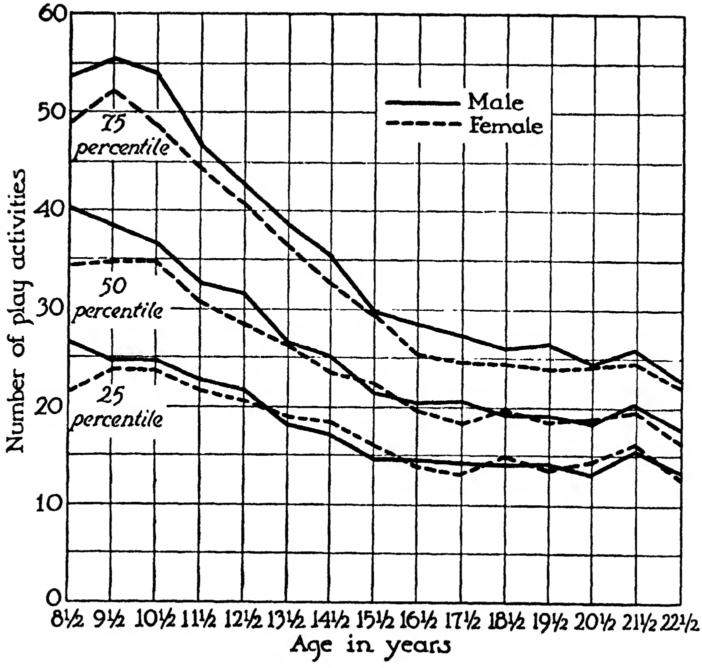


FIGURE 67

NUMBER OF PLAY ACTIVITIES REPORTED AS HAVING BEEN ENGAGED IN DURING THE PAST WEEK BY BOYS AND GIRLS OF DIFFERENT AGES

(Modified from *The Psychology of Play Activities* by H. C. Lehman and P. A. Witty.)

These differences are strikingly shown in Figure 67. In this figure the two center lines show the average number of games reported by each sex at each age. The upper and lower sets of curves mark off the range of the middle 50

per cent. Twenty-five per cent of the children report more games than the numbers indicated by the upper pair of graphs; 25 per cent report fewer than the numbers indicated by the lower pair. Up to the age of thirteen every one of the 200 activities was reported by more than 1 per cent of the children, but after that age more and more of them were eliminated (that is were checked by no one or at least by fewer than 1 per cent) until by the age of 22 more than half of the activities had been eliminated entirely.

Sex differences in preferred forms of play appear to be most marked between the ages of eight and ten years. Older boys and girls are more alike in their play interests, but at all ages boys are more interested in active, competitive, highly organized games, while girls prefer games of a more sedentary nature. Football is played almost solely by boys; playing with dolls is almost wholly confined to the girls. Social custom is probably responsible in part for this difference.

The play life of a child also tells us a good deal about his social maturity. Furfey * has worked out a kind of scale or test based largely though not entirely upon play interests, from which he obtains a measure that he calls "developmental age." The developmental age of a child gives us a rough measure of the maturity of his total personality. It is not the same thing as mental age for some very bright children are babyish in their behavior. It is not the same thing as physical size for some children who are small physically display a striking degree of independence and general social maturity. Both mental age and physical size have something to do with it, but social and play interests are the chief factors.

Developmental age is of considerable importance in determining children's friendships. Children of about the same

* P. H. Furfey, "A Revised Scale for Measuring Developmental Age in Boys," *Child Development*, 1931, 2: 102-114.

developmental age are more likely to become close friends than those of the same chronological age or the same mental age whose developmental ages differ.

The extent of a child's social participation is another important matter revealed by his play life. Does he usually play alone or with other children? In some of their studies

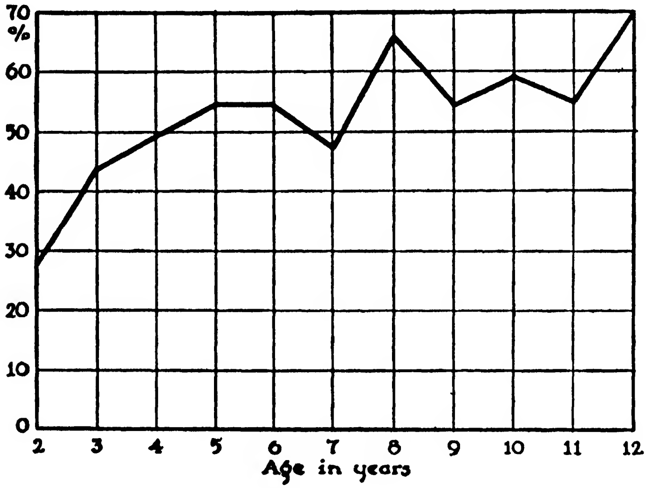


FIGURE 68

PERCENTAGE OF CHILDREN AT EACH AGE WHOSE FAVORITE COMPANIONS ARE WITHIN A YEAR OF THEIR OWN AGE

(Adapted from Report of Committee III B., White House Conference on Child Health and Protection.)

Lehman and Witty had each child state for each of the games that he checked whether it was played alone or with other children. They found that about 2 per cent of the children between the ages of eight and twelve years played alone more than 90 per cent of the time and that at the other extreme there were 10 per cent of children who played alone less than 10 per cent of the time. Although in dealing with individual children one must always take into consider-

ation the fact that some have little opportunity to play with other children while in other cases, notably among twins or members of large families, solitude is equally hard to obtain, nevertheless after entering school the child's own preference is the chief factor in determining whether he shall play alone or with other children, at least in the majority of cases. Lehman and Witty suggest that by the use of a play quiz such as this it is possible to pick out the children who are lacking in good social attitudes. Then one may try to find out the reasons for their solitude and help them make a better social adjustment. Perhaps some of the children at the opposite extreme might also profit by being shown how to amuse themselves more effectively, if it is found that they are overly dependent on companionship and have few resources for entertainment within themselves.

At all ages, but especially between the ages of six and twelve, boys tend to play with boys, girls with girls. Both boys and girls usually prefer companions who are near their own age.

Direct Observation of Behavior as a Method of Studying Child Personality

Most of our ideas about the personalities of other people are formed by just happening to notice how they behave under various conditions. But as we have already seen, casual observation of this kind is not a very safe guide. We are likely to be attracted by something that is exceptional and overlook the thing that is usual. If our emotions are aroused, if the person happens to do something that irritates us or causes us a good deal of inconvenience or anxiety or, on the other hand, if he does something that particularly pleases or flatters us, or arouses our sympathy, our judgment of him afterward is likely to be so strongly colored by the single outstanding experience that everything else we have known about him fades into insignificance. Although

when people are asked for a statement about the personality of some one whom they know they are likely to begin by saying, "In all my experience with him . . ." or, "He has always impressed me as . . ." or some equivalent phrase, the fact is that because so few of one's "experiences" with other people make any lasting "impression" at all, such statements have a much less general meaning than the person making them is likely to suppose.

When one wants to find out something about a particular kind of personality trait a special method of observation known as the "time-sampling" method will do a good deal to correct errors of this kind. In the time-sampling procedure, children or adults are observed for definite short periods of time and their behavior during each period is looked upon as a "sample" of their usual behavior. Of course a single sample would not mean much but a sufficiently large number of samples taken on different occasions will give us a much more exact idea of a given child's behavior than we are likely to get by spending the same amount of time in just watching him without definite object. For example, if on each of twenty days we take a five-minute sample of Billy's behavior on the school playground and find that on nineteen of the twenty occasions he is just standing around by himself, while a similar series of twenty samples of Jerry's behavior finds him playing with the other boys every time, we are not likely to go wrong in saying that Jerry is the more socially minded of the two.

Employing this method Olson * studied a number of "nervous habits" in school children as shown in the classroom. His method was to take a position where he could easily see all the children in the room and then, by the aid of a seating plan, a stop-watch, and a pencil, to keep a careful record of all instances of such "nervous symptoms"

* Willard C. Olson, *Measurement of Nervous Habits in Normal Children* (Minneapolis: University of Minnesota Press, 1929).

as putting the finger into the mouth, fingering the hair, picking at the nose, pulling the ear. Only one of these symptoms or habits was observed at a time. Every child who displayed the habit at least once during a five-minute period got a check mark after his name. If the observation was continued for twenty five-minute periods, then the number of check marks for any child might be anywhere from zero, if there were no indications of the habit at all, to twenty, if it was observed one or more times during every five-minute period. It was found that when the same group was observed twice the children behaved pretty much the same from one occasion to another, if the observations were not more than a week or so apart. Even after a year's time there was still evidence of persistence of the habits shown on the first occasion. But as the interval between observations increased, the number and extent of the changes shown by individual children became greater, thus bearing out the popular opinion that habits like these wax and wane as time passes. It was also found that there were "nervous areas" within the various classrooms corresponding in a way to the "delinquency areas" in a city. Here and there were little groups of two or three or half a dozen children sitting near each other, all of whom showed these habits to a much greater extent than the average. By making a special study of children before and after their regular classroom seats had been changed, Olson was able to show that children are likely to copy such habits from their near neighbors without knowing that they are doing so. Merely sitting next to another child who is continually picking his nose or rubbing his ears or putting his finger into his mouth for several hours a day may be enough to start the same habits in one who had previously been almost completely free from them. Habits such as these are as contagious as measles, and the "nervous areas" observed by Olson had presumably developed as a result of this social contagion.

Rating Scales

Sometimes, instead of observing and recording child behavior at the time it occurs, persons who know the children in question are asked to state the impressions they have formed about the personality traits of each child by checking the position they think he occupies on a rating scale. As a rule, rating scales include a large number of items which the rater is supposed to check. Many different ways of expressing the ratings have been used. Sometimes the checking is to be done by underlining the appropriate term in a list as in the following examples:

Is his general health excellent, good, fair, poor, very poor?

Does he usually move very rapidly, more quickly than the average child of his age, at about average speed, rather slowly, very slowly?

Sometimes the various classifications are arranged along a line and the rater is asked to put a cross at the point where he thinks the child belongs, as in the scale below:

Interest in reading

Reads only when required to do so. No interest in books	Reads occasionally, but prefers other kinds of amusement	Reads about average amount	Spends more than average amount of time in reading	A bookworm. Reads everything he can lay his hands on
:	:	:	:	:

Rating scales are nothing more than opinions that are put down on paper. Everybody forms such opinions about the children with whom he deals, and most people have a good deal more faith in their own opinions than experimental studies of the reliability of ratings have shown to be warranted. But right or wrong, these opinions are not

without their effect. The child who realizes that his teacher thinks him stupid, untrustworthy, lazy, is more than likely to live up to her expectations, while the one who has a reputation for honesty, industry, or high class-standing will make a strong effort to hold his place. Unwritten "ratings" by parents, teachers, and playmates, whether they have been deserved or not, play a much greater part in the development of personality traits during childhood than most of us realize.

Case Histories

Another favorite method of studying personality and conduct is by means of the *case history*. A case history is a systematic account of the child's development and behavior, collected, as a rule, in the hope that it may throw light on some particular problem. Of course there is no reason why case histories should not also be obtained for children who are not regarded as "problems," but this is not often done. The conventional case history begins by telling something about the family history, describes the home and neighborhood, outlines the main facts in the child's early development, then gives a detailed description of his present behavior, particularly those aspects of it that are thought to have a bearing on his difficulty. The aim of the case history is to give a complete and colorful account of the child's personality and of the factors that seem to be influencing his behavior.

The great advantage of case histories over other methods is that they are more comprehensive. They do not stop with a single trait or even with ratings on a number of traits, and they do not leave out the world in which the child is living. Instead they attempt to present a comprehensive picture of the child's personality in its actual setting, and when this is done faithfully and without prejudice the case history may be very valuable as a means of understanding the indi-

vidual child. The difficulty lies in getting a really unprejudiced picture. The very fact that most case histories have to do with children who present behavior problems of some kind means that most of the people who have known these children have built up rather strong emotional attitudes toward them. The children have irritated them, caused them worry, embarrassment, disappointment. And since these are the very people who have to furnish most, if not all, of the information about the children who are to be studied, it becomes very hard to know how much credit can be assigned to their reports.

How the Child Looks at It

Observations, ratings, case histories, if carefully collected under a variety of conditions and by the aid of enough persons to give us a fairly representative cross-section of a child's daily life, will tell us a great deal about his personality, as far as it can be viewed from the outside. And that, you will remember, is the first criterion by which the total personality is judged. It answers the question, What do other people think of him? But there remains the other side, the more personal side that deals with his own reactions toward the rest of the world and toward himself. How shall we get at this?

Here for the most part we have to rely on what the child tells us, though we can infer some things from his behavior. Physiological measures such as changes in blood-pressure, in heart-rate and breathing-rate, and in the electrical resistance of the skin * when the child is placed in situations or

* The electrical phenomena of the skin are measured by means of an instrument called a galvanometer. Electrodes are placed in contact with two different points on the skin and connected to form an electric circuit. Because the two points differ in electric potential, a current is generated. There is evidence that under strong emotion, changes in potential occur, and since the amount of this change will not as a rule be the same at both points, changes also occur in the amount of current that is generated. The extent of these changes is measured on the galvanometer, and

questioned about matters that are thought to be associated with his personal difficulties are also used at times, but these measures are usually hard to interpret. In studies of individual children, getting the child to give his own account of his difficulties is often very helpful. Of course care must be taken to win the child's confidence and make him feel that he is not being asked for a confession but for a simple account of what took place and why he thinks things happened as they did. Here is an instance.*

Tom started running away by following bands and parades. Before he entered school he had already been picked up by the police several times. After he entered school his running away increased and was associated with truancy. By the age of nine, he had run away so many times that his mother could not even give an estimate of the number. He usually returned with his pockets full of small change which he claimed people had given him for singing. (Whether or not any of the money was stolen could not be found out, but it was known that he sometimes obtained money by begging and singing in parks and amusement places. He could sing very well for a child and knew a large number of songs.)

When questioned about his running away this was his story:

"I started myself running away. Something made me start—something in my head—it might be the devil." In answer to questions, he said it was his mother who said the devil got into his head. But the explanation is interesting for it illustrates the way in which children (and sometime grown people as well) grasp at almost any kind of concrete explanation for the overwhelming urge to escape from an unpleasant situation and return to one that has previously been found pleasant. If they have been taught that it is wrong to do this and if the temptation is still

by noting the circumstances under which they occur, factors that are causing emotional conflicts can sometimes be discovered.

* This and the following case report have been adapted from *Case Studies* by Healy and Bronner, as reported by W. I. and D. S. Thomas in *The Child in America*. However, the interpretations given here are not entirely in agreement with those in the original reports.

too great to be resisted, it simplifies matters greatly if they can convince themselves that after all they are not responsible, that they were "made" to do it. The devil makes a convenient alibi under such conditions.

Tom then went on to tell about his school. "One reason I run away is because I don't like school. I never did like it and I don't like it now. It's too hard. I would like it in school if they would let me draw pictures but they only let the children draw apples and pears. The arithmetic is too hard. I don't like reading either. I can't learn it." Again and again he repeated, "That's what's the trouble, I don't want to go to school."

Then he told about the good times he had when he ran away. Sailors and other people took him into places and gave him a good time. At parks he always made quite a little money by begging and singing. Once he crawled under the flying horses to get a sailor's hat and he got fifty cents for it.

Tom's story is interesting because it shows how the simple and everyday laws of human behavior account for the development of undesirable forms of behavior as well as for the desirable ones. From an early age, Tom had more than the usual interest in music and so bands and parades had even more attraction for him then they have for most children. We may infer, too, that he was independent and fearless. What more natural than that he should follow the band when it came by? He was friendly and good natured and strangers made much of him. When the police eventually picked him up, they were kind to him and saw that he reached home safely. When he got home he was the hero of the day, and his parents were so relieved at his safe return that any punishment they may have given him was of a rather perfunctory nature and didn't hurt much.

By and by he entered school, and found, as many other children do, that the work was "hard" and uninteresting. But unlike most children of his age he had learned a way

of escape, and he took this way more and more frequently as time went on. Just what started him out on his career of singing and begging we do not know, but there are plenty of ways it might have happened. He may have seen some one give money to a street musician and decided that he also could earn money that way. He may have been singing for his own amusement and have been given money in payment, or some one may have suggested the possibility to him. At any rate he learned that by running away from home and school, begging and singing and making friends with good-natured sailors, he could have much more fun than more conventional behavior was ever likely to bring him.

The common sense remedy would seem to lie in putting the rewards and punishment in the right places. School could undoubtedly be made more pleasant; long periods without running away might be rewarded; and by enlisting the aid of park authorities some check might be placed on his begging. But the important thing is to get him to see for himself that such behavior is undesirable. Outside control is a poor substitute for self-control.

The following case shows how stealing may result from imperfect understanding of property rights:

A little girl of eight and a half was in the habit of taking money from her mother's purse. On one occasion she took five dollars from the purse of a guest. She never spent the money by herself but always shared it with other children.

This is her story:

"I would like to go to school only I am punished a lot of times. Sometimes they don't let me downstairs and whip me a lot of times. Punish me for taking pencils and penholders from the other children. I take them and use them and when I put them back they tell teacher. I never take money from school, only from mama. I never meant to keep the penholders."

When asked why she took the money from her mother,

she answered, "When I see other kids have it I want it and then I take it." Asked if she thought it right to do so she answered, "No, I just wanted it. I take sometimes and then sometimes I don't take."

Taking money from her mother was not stealing to her, for things belonging to the home were looked upon as common property and taking money was to her no different from taking anything else she might happen to want. The etiquette of borrowing, too, was not clear to her. What harm in taking the penholders if she put them back? She herself was ready enough to share, as is shown by the fact that she always invited other children to help her spend the money she took.

No child is born with a natural understanding and respect for the rights of ownership. This has to be learned. The case report of this child fails to tell us whether or not she had an allowance of her own which other people were not allowed to touch, whether borrowing without permission was accepted as a matter of course at home as it is in a good many households, in short whether or not she herself had ever had enough experience with ownership to get a clear understanding of what stealing is. Her story is distinctly that of a puzzled child who knows well enough that she is punished "a lot of times" but doesn't see why.

Often a good deal can be learned about a child's point of view by asking him what he would ask for if a fairy were to appear and offer to grant him three wishes.*

The nine-year-old son of a much married and divorced mother was taken by her to the juvenile court on a charge of incorrigibility. No one else who knew the child had ever had any trouble with him. At school he was popular and well behaved. When questioned he made no direct complaint about his mother but his real feeling was revealed in the

* See F. L. Goodenough, "The Diagnostic Significance of Children's Wishes," *Mental Hygiene,* 1925, 9: 340-345.

first of his three wishes which was "for a nice home and mother." Children who already have a home and mother of this kind do not need to wish for them. Somewhat similar is the case of another boy of about the same age whose mother was admittedly very partial to a younger brother because the latter so strongly resembled her dead husband. Blotted and misspelled, this child's chief wish was "that I wood be lovved by my fokes."

The only son of an ambitious Jewish family, who were determined that the boy should be a famous scholar in spite of an intelligence quotient slightly below average, had been driven and coached and made to study at all hours until at the age of eleven he had managed to reach the eighth grade. Here he was failing for the first time and his parents were in despair. He had never been allowed to play with other children because all his time must go to his home lessons and to the Hebrew school which he attended daily from four to six in the afternoon. He was timid and fearful to an extent that can hardly be imagined, and after the fashion of thoughtless childhood the other boys took delight in teasing and frightening him. His three wishes tell a good deal of the nervous strain under which he suffered:

1. That I would have enough sense to think so that I would never stumble but answer all questions correctly.
2. That no one would do me harm.
3. That I would be rich when I am a man so that I could make a living.

What the School Child's Personality Signifies

Even if we could measure the personality of school children with absolute precision it is unlikely that we could tell from such measurements into what kind of an adult each individual child is going to develop. To do that we should have to know not only what a child is like now but what influences are going to come into his life from now on. But there is no doubt that we could make a guess which would be much more likely to be right than wrong. Even with the imperfect methods of studying and describing personality that have been worked out so far, we can detect in the

school children of to-day many of the traits that will characterize them when they grow up. The solitary child with few friends may grow to be a man with marked social interests, but the chances are against it. The child who rebels against all authority may, as he grows older, become a docile follower of the crowd, but he is more likely to develop into an aggressive, truculent type of person who goes around with a chip on his shoulder and takes offense at the least excuse. Habits and attitudes that are so greatly "overlearned" in childhood as these are likely to be, in time become as automatic as reciting the alphabet or swimming. The same laws of learning that apply to typewriting, memorizing nonsense syllables, learning to run a maze, or becoming "conditioned" to expect food when the dinner bell rings, hold good also for learning to run away from school or home, taking other people's possessions or refraining from doing so, lying to get out of trouble or telling the truth, preferring to play alone or with other children, or preferring "boys' games" to "girls' games."

Of course these alternatives are not equally balanced in regard to ease of learning. The little child does not have to be taught to take what he wants if he can get it; it is refraining from taking what is not his own that has to be learned. Probably it is easier to teach children to lie as a way of getting out of trouble than it is to teach them to tell the truth and face the consequences. Probably, too, there are inherited differences among children of a kind that make it easier to teach some to inhibit their natural tendencies to grab whatever they want, or to train them to stick to a thing until it is accomplished, or to develop in them the kind of behavior that makes them popular with other children. The evidence for the inheritance of such behavior tendencies is not so clear as is the evidence in regard to the inheritance of either general ability or certain special talents such as musical ability. It seems fairly certain that at most

what is inherited in these cases is not an absolute determining factor but only a tendency, a predisposition, that may make it more difficult to develop the right kind of social and emotional habits in some children than it is in others but does not render it impossible to do so. Some psychologists refuse to concede heredity even as minor a rôle as this in the determination of behavior but put their whole faith on the side of learning. That learning plays a tremendous part there can be no doubt.

Parents and teachers are particularly likely to overlook the personality defects that are of chief concern to the child himself. They worry about the child who disobeys or fights or steals or gets into sex difficulties because such behavior is both conspicuous and disturbing to other people, especially to those in charge of him. But the child who has troubles of his own and keeps them to himself, worrying and brooding over them in secret; or the one who finds real life so hard and unpleasant that he slips away into a dream world, shunning companionship and withdrawing further and further into his unhappy self is not likely to impress many people as being a problem because he does not bother anybody except himself. But in reality such children are quite as much in need of help as the ones who make themselves actively troublesome. Often their need is greater, for if matters are not corrected and such a child continues to spend a large part of his time and his emotional energy in brooding over his troubles when he should be doing something worth while, if he stays off by himself instead of learning how to get along with other people through the give and take of healthy play, if he forms the habit of retreating from difficulties instead of meeting them squarely, he will be poorly equipped for holding his own in the active competition of adult life. Behavior such as this is always a sign of mental ill-health. The child may get over it, to be sure, just as he may recover from physical illnesses that are

allowed to run their course without proper attention. But it is foolish to trust to luck when a child's future success and happiness are at stake.

What can be done? The rule is easy to state, but to carry it out often means long and painstaking effort.

Find out the cause of the trouble.

Remove the source of difficulty if possible. If not, help the child to take an unemotional attitude toward it. This can best be done by so arranging his life that the troubling factor, whatever it may be, will interfere with it as little as possible.

Help him to form a new set of behavior patterns. Even if the actual difficulty is removed, his old habits which have been practised so long will continue to assert themselves unless new ones are acquired. Keep the principles of learning in mind. Make sure that desirable behavior brings satisfaction. See that he has plenty of opportunity for practising his new social skills, but don't overdo it. Avoid forcing him into too many new and untried situations at once.

The same principles hold good with the delinquent child who is a more active source of difficulty. Here, too, there is a reason or perhaps a whole series of reasons back of the anti-social behavior. But even after the reason has been discovered and the original difficulty corrected, the problem of retraining remains. Habits practised for years will not disappear by magic. Definite effort is necessary to get rid of them.

Training should be positive. Just harping on what not to do will not take one very far. The thing that the child needs is to learn what to do and to get satisfaction by doing it.

Chapter XX

ADOLESCENCE

What are some of the early signs of the approach of adolescence?

What is meant by pubescence? About how long does pubescence usually last? What event marks the beginning of adolescence in girls? How is puberty determined in boys?

At about what age is puberty commonly reached in girls? In boys? How much normal variation from these averages occurs in individual cases?

What is meant by secondary sex characteristics? Give some examples.

Why are adolescents often clumsy in their movements? Is it necessary for them to be so?

Are sex interests and sex emotions normally present before adolescence? What causes them to become increased at puberty?

In what ways is interest in the opposite sex likely to be shown during pubescence and early adolescence? Why is this phase of sex behavior important for the development of normal sex attitudes later on?

Why does the gang or clique exercise such an important influence on the attitudes and behavior of the adolescent?

How do the laws of habit-making and habit-breaking apply to the relationships between the adolescent and the adult members of his family?

Duration of Adolescence

In girls at about the age of eleven or twelve and a year or so later in boys, certain physical changes begin to appear which show that the time of puberty is approaching. In most cases, however, from one to two years must elapse before the pubertal changes are completed. This transitional period from childhood to adolescence is known as the *period of pubescence*. In girls it is terminated at the onset of the first menstruation, after which the girl is said to be *adolescent*. In boys, the boundary line between pubescence and adolescence is not marked off by any one sudden and conspicuous event. In practice, the change of voice, the growth of the beard, and the growth and character of the pubic hair * are the signs generally taken into consideration in determining when puberty is reached in males.

In both sexes the age of puberty varies greatly from one child to another. More than 50 per cent of American girls first menstruate between the ages of thirteen and fifteen years. A few menstruate as early as the age of nine or ten, and menstruation is sometimes delayed until nineteen or twenty. In boys much the same range of individual differences is found, but the average age at puberty is from one to two years later than in girls.

The upper extreme of the period of adolescence is not very definitely marked in either sex. Generally speaking we say that adolescence ends when the individual is grown up, but both physical and mental growth slow off so gradually that it is hard to determine just when they finally come to a stop. Gain in height is the most easily measured of the growth factors, and it has practically ceased by the age of eighteen or nineteen in girls and twenty in boys. It has

* Crampton makes the distinction on the basis of the appearance of the curl or kink in the pubic hair which is characteristic of maturity. During pubescence some pubic hair is present but it is straight and scanty.

become customary, therefore, to place the end of the period of adolescence somewhere between the ages of eighteen and twenty. In this book, however, the college student will be considered separately, hence our discussion of adolescence * will include, roughly speaking, the years from twelve to eighteen. As a rule this means the junior and senior high-school periods.

Physical Growth During Adolescence

One of the first signs of approaching adolescence in both boys and girls is a sudden and very marked spurt in physical growth, especially growth in height. The long bones of the arms and legs stretch out with such amazing rapidity that gains in height of as much as six inches in a single year have been known to occur. Trousers, skirts, and sleeves have to be continually lengthened, only to be outgrown again almost before the remodeling is completed. Gain in weight also occurs, but as a rule it fails to keep pace with gain in height and so for a time we have the gangling long-legged boys and girls who seem to be chiefly made up of knees and elbows.

The most rapid increase in physical growth comes during pubescence. After puberty is attained, bodily growth begins to slow down, and the gain becomes less and less each year until it finally ceases completely.

The facial proportions change. The lower jaw has been growing much faster than the upper portions of the skull since birth, and it now participates in the general growth spurt with the result that in a few months much of its former childish contour is lost and the face begins to take on a definitely grown-up appearance. (See Figure 38.) This is accompanied in boys by a decrease and in girls by an increase in the layer of fat just underneath the skin. This causes the girls' faces to become softer and more rounded

* Including pubescence.

in outline, while the boys' faces grow more angular and their flesh feels harder.

The fine hairs on the surface of the body become somewhat coarser and longer and more strongly pigmented. This is true in both sexes but especially in the male. In the male, too, the beard begins to grow about the time of puberty, and within a year or so shaving becomes necessary. In both sexes the voice also changes at adolescence, becoming lower in pitch and more resonant. In girls, however, the change in voice is much less pronounced than it is in boys. In boys the larynx or "Adam's apple" becomes noticeably enlarged and the vocal cords which are within it increase greatly in length. It takes a year or more for this change to be completed and during this time the voice may be noticeably harsh and discordant, often getting out of control. Sometimes there are queer and unexpected shifts in pitch, when the voice without warning jumps from a deep bass to a husky squeak.

Physical characteristics of this kind, which do not involve the primary sex organs but which nevertheless differ for the two sexes, are known as secondary sex characteristics. For the most part, secondary sex characteristics are small and inconspicuous during childhood, but they begin to show up clearly during pubescence and in the adult they are very marked. Nevertheless in most cases the differences between the sexes in regard to these matters are differences of degree rather than kind. Most men have beards and mustaches and most women do not, although in many women there is a visibly heavier growth of the surface hairs on the upper lip than on other parts of the face. On the average, men's voices are deeper and more resonant than women's, but this is not invariably the case. So with the other secondary sex characteristics. On the average they differ for the sexes after the age of puberty, but there are individual exceptions.

Motor Control in the Adolescent

There is a popular notion that the adolescent is always awkward and clumsy. Stories of adolescents usually picture them as perpetually knocking things over, stumbling over their own feet, breaking everything that they touch. The reason commonly given is that the arms and legs have grown so fast and take up so much more space than they

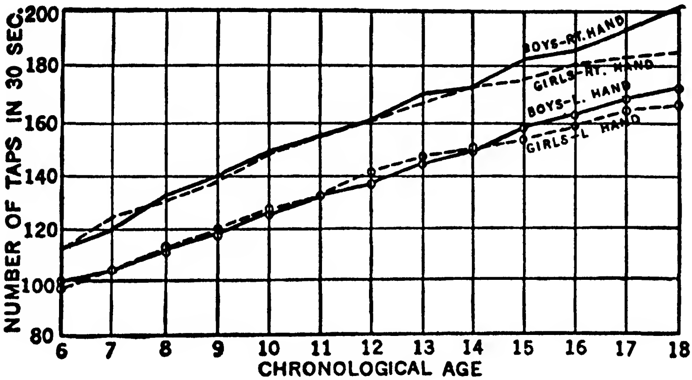


FIGURE 69

IMPROVEMENT IN SPEED OF TAPPING DURING CHILDHOOD AND ADOLESCENCE

(After Bryan. From *The Psychology of Adolescence* by F. D. Brooks. Houghton Mifflin Co.)

ever did before that their owner no longer knows how to handle them.

There is not the slightest ground for the idea that children lose in motor ability or in the power to coördinate their movements during adolescence. Instead, they continue to improve, not so rapidly as they did in childhood to be sure, for growth both in mental and motor abilities is beginning to slow down by this time. But though growth is slower it continues without interruption. (See Figures 69-70.)

It is easy to see, however, why some children do show

an increased motor awkwardness at this time. Changes in their appearance are so marked that people are always commenting on it, often in rather tactless fashion.

"Gracious, how John is stretching out. And look at the size of his feet!"

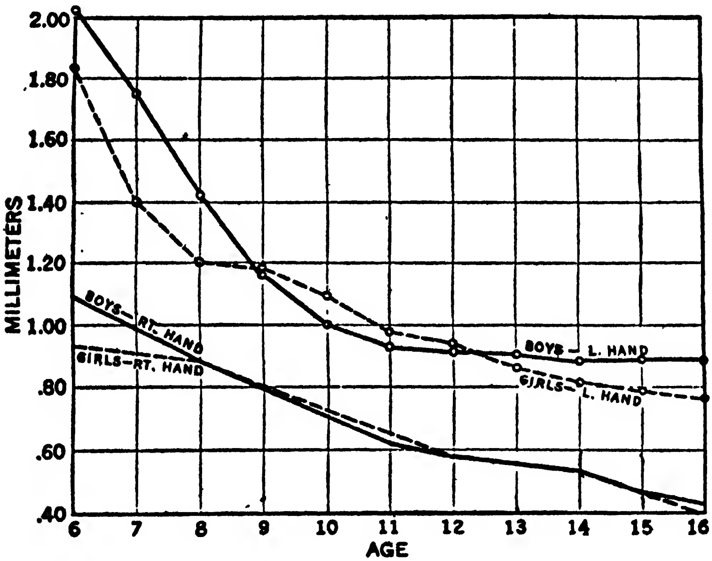


FIGURE 70

IMPROVEMENT IN PRECISION OF VOLUNTARY MOVEMENT DURING CHILDHOOD AND ADOLESCENCE

Precision is measured in terms of the number and extent of errors made in tracing a line.
(After Bryan. From *The Psychology of Adolescence* by F. D. Brooks. Houghton Mifflin Co.)

"My goodness, don't tell me this is little Mary! Why, she used to be such a dainty little girl. I never in the world would have known her."

Daily exposure to remarks of this kind can hardly help but embarrass and annoy a sensitive child, even though no unkindness is intended. Often the adolescent member of a

large family is made the butt of a great deal of chaffing about his appearance. His clothes that are perpetually too short, his hands and feet which are made doubly conspicuous by protruding so far out of his outgrown garments, his voice with its unexpected growls and squeaks, all come in for their share of banter. Even though he takes it good-naturedly, some degree of self-consciousness is almost certain to be the result, and as most of us know from experience there is nothing like self-consciousness for disturbing one's motor control. It is an exceptional golfer whose drive cannot be interfered with by remarks about his personal appearance, particularly if he knows them to be true. The adolescent who is so clumsy and awkward that disaster seems to follow wherever he goes may show surprising dexterity of hand in his workshop when no one is watching him and splendid bodily control on the athletic field. His awkwardness in public is not due to lack of motor skill but is the result of embarrassment and self-consciousness.

The Growth of Sex Interests

Formerly it was thought that sex interests and sex desires did not exist before puberty. This is not the case. Even very young children show evidence of sex feelings that appear to be similar to, if not identical with, those appearing later. But it is unquestionably true that at adolescence sex drives become far stronger and more definitely patterned than they are in childhood. The little child enjoys being petted and caressed by almost any one of whom he is fond. But his enjoyment is evidently not very intense as any one can determine for himself by offering a counter-attraction such as a bit of candy or an interesting toy. It does not take much to induce the child to wriggle away from the fondler and become absorbed in the new interest. A much stronger counter-interest is required to distract a boy or girl of seventeen from the joys of a petting party.

Because the sex interests of the pre-pubescent child are normally so vague and diffuse and so overshadowed for the most part by other and more immediate drives, it is not strange that their existence was long ignored. Indeed, during the greater part of the elementary school period most children react toward the opposite sex in a way that to the casual observer would more nearly suggest sex aversion than sex attraction. Boys are reluctant to permit girls to join in their play and girls are likewise intolerant of the behavior of the boys. But closer observation suggests that much of this apparent antagonism is merely a cloak by which a very real interest is concealed.* As children grow older more contacts between the sexes can be noticed. In the pubescent or early adolescent child, these contacts retain much of their earlier appearance of surface antagonism. They take the form of teasing, of pulling and hauling each other about, scuffling, or "razzing" each other, and this back-handed way of showing mutual interest is particularly likely to be resorted to if observers are present. Another way of showing sex interest that is particularly characteristic of the adolescent, though it is far from being unknown among older persons, is the "showing off" so ably described by Mark Twain.

"Tom watched and watched, hoping whenever a frisking frock came in sight and hating the owner of it as soon as he saw she was not the right one. At last frocks ceased to appear, and he dropped hopelessly into the dumps; he entered the empty school-house and sat down to suffer. Then one more frock passed in at the gate and Tom's heart gave a great bound. The next instant he was out, and "going on" like an Indian; yelling, laughing, chasing boys,

* We must not assume that the banding together of boys and girls in separate groups is purely the result of sex interest running in reverse. Interest in different kinds of games and amusements has a good deal to do with it. Social custom which permits boys much more freedom to roam about unsupervised than it allows to girls is also a factor, since the presence of girls among a group of boys definitely limits their activity.

jumping over the fence at risk of life and limb, throwing hand-springs, standing on his head—doing all the heroic things he could conceive of and keeping a furtive eye out, all the while, to see if Becky Thatcher was noticing. But she seemed to be unconscious of it all; she never looked. Could it be possible that she was not aware he was there? He carried his exploits to her immediate vicinity; came war-whooping around, snatched a boy's cap, hurled it to the roof of the school-house, broke through a group of boys, tumbling them in every direction, and fell sprawling himself, under Becky's nose, almost upsetting her—and she turned with her nose in the air and he heard her say, 'Mf! some people think they're mighty smart—always showing off!'"

But Tom's turn is to come a few chapters further on after his dramatic return from the "pirating" expedition to attend his own funeral. Now he has become the village hero and at school the children vie with each other to be seen with him.

"Tom decided he could be independent of Becky Thatcher now. Glory was sufficient. He would live for glory. Now that he was distinguished maybe she would be wanting to 'make up.' Well, let her—she should see that he could be as indifferent as some other people. Presently she arrived. Tom pretended not to see her. He moved away and joined a group of boys and girls and began to talk. Soon he observed that she was tripping gaily back and forth with flushed face and dancing eyes, pretending to be busy chasing schoolmates and screaming with laughter when she made a capture; but he noticed that she always made her captures in his vicinity, and that she seemed to cast a conscious eye in his direction at such times, too. It gratified all the vicious vanity that was in him; and so, instead of winning him it only 'set him up' the more and made him the more diligent to avoid betraying that he knew she was about. Presently she gave over skylarking and moved irresolutely about, sighing once or twice and glancing furtively and wistfully toward Tom. Then she observed that now Tom was talking more particularly to Amy Lawrence than to any one else. She felt a sharp pang and grew disturbed and uneasy at once. She tried to go away but her feet were treacherous and carried her to the

group instead. She said to a girl almost at Tom's elbow—with sham vivacity;

'Why, Mary Austin! you bad girl, why didn't you come to Sunday-school?'

'I did come—didn't you see me?'

'Why no! Did you? Where did you sit?'

'I was in Miss Peter's class, where I always go. I saw *you*.'

'Did you? Why, it's funny I didn't see you. I wanted to tell you about the picnic.'

'Oh, that's jolly. Who's going to give it?'

'My ma's going to let me have one.'

'Oh, goody; I hope she'll let *me* come.'

'Well, she will. The picnic's for me. She'll let anybody come that I want and I want you.'

'That's ever so nice. When is it going to be?'

'By and by. Maybe about vacation.'

'Oh, won't it be fun! You going to have all the girls and boys?'

'Yes, every one that's friends to me—or wants to be' and she glanced ever so furtively at Tom, but he talked right along to Amy Lawrence about the terrible storm on the island, and how the lightning tore the great sycamore tree 'all to rlinders' while he was standing 'within three feet of it.'"

Interest in the Opposite Sex Is a Normal Aspect of Adolescent Life

The sex drive is not the child of sin, as our Puritan ancestors represented it to be, but of physiology. At the time of puberty and even before, during the period of pubescence, marked changes take place in the secretions of the ductless glands, especially in those coming from the gonads or sex glands. It is to these secretions or *hormones*, as their active elements are called, that we owe the great changes in bodily form and appearance that were described at the beginning of this chapter. Remove the glands before puberty and but few of the secondary sex characteristics will appear. Remove them after puberty and many of the characteristics will

become greatly modified. If these secretions are powerful enough to change the bodily form, alter the distribution of fat cells, cause a beard to grow on the smooth face of the boy and modify the pitch of his voice, it is not surprising to find that changes also take place in the fundamental drives by which behavior is motivated, as well as in the behavior itself.

The fact that in our present state of society the sex drive cannot be completely gratified as soon as it is felt introduces a good many complications for the adolescent. A generation or two ago, when about the only way of dealing with the matter was to try to keep the sexes apart until the proper time for courtship and marriage had arrived, the problems confronting the adolescent were somewhat different from those likely to be faced by the growing boy or girl to-day when greater freedom of association is the rule. But even now, many find it difficult to make the transition from the social life of childhood which centers so largely around friends of their own sex to the normal social life of the adult which involves both sexes. Sensitive children are sometimes kept from having anything to do with companions of the opposite sex by the good-natured chaffing and ridicule of more sophisticated older brothers and sisters to whom their awkward and embarrassed flounderings in the direction of love-making are supremely funny. Sometimes, either from too much reading of romantic tales or from ideals unwisely instilled by parents in an attempt to prevent the formation of undesirable attachments, adolescents get such an exaggerated idea of the importance of any association between the sexes that they cannot take even a chance acquaintanceship casually and naturally. The rough and ready play, the pushing and tussling between boys and girls whose adolescent interests are just beginning to show themselves is the best possible preparation for building up the open, unabashed, and healthy attitudes toward persons of

the opposite sex that are so necessary for happy adjustment later on.

The Social Life of the Adolescent

Not only does the adolescent, as a rule, begin to show a new interest in the opposite sex, but a new element appears in his relationships with persons of his own sex. This is the formation of clubs or gangs. It is, of course, true that long before the age of adolescence children play together in groups and form special friendships that give these groups something of a lasting character. But in most cases the social groups formed by young children lack the solidarity and the feeling of group-consciousness that characterize the adolescent gang or club.

The typical boy's gang is closely organized about a leader. The leader may earn and hold his place by force of arms—his own flesh and blood arms including the fists in which they terminate. This is likely to be the case when the gang is organized chiefly for fighting and must hold its own against other neighboring gangs. Or he may be chosen because of his athletic ability, his cleverness in planning and carrying out small pilferings, or for any other special aptitude that furthers the group interest. The leader must be a good deal of a dictator, able to down those who question his authority, else the gang will soon break up. But he must also be able to convince the other members of the group that his dictatorship is just, according to boyish standards.

Girls as well as boys form a good many special clubs and cliques during early adolescence, but with the exception of those under adult supervision they are not likely to be as highly organized or as closely knit as the spontaneous social groups formed by boys. The boys' gang usually has a name; the girls' clique rarely has one unless an adult provides it or at least suggests the idea. The girls' group is more likely to be organized around three or four close friends who unite

in deciding who shall be admitted to the group and who shall be excluded from it. For the most part their decisions are made on purely personal grounds. The boys' gang has a definite leader about whose identity there is no question, but if a girl is asked who is the leader in her group she is more likely to name two or three persons than one. The boys' gang has a fairly definite purpose. It may be athletics, it may be plundering, it may be fighting, it may be hiking. The girls' club is less likely to center around any particular activity. Its members, however, share among themselves various "secrets," bits of gossip, and so on to which they often refer mysteriously in the presence of outsiders in the hope of arousing curiosity and envy.

Both with girls and boys the club or gang gains its solidarity quite as much by excluding certain persons as by admitting others. In this respect it is very like the social cliques established by older persons. Mary objects to inviting Susan Brown to her party "because she doesn't belong to our crowd" and her mother "never sees anything" of her next-door neighbor who belongs to a different social "set" And like their elders, adolescent boys and girls look upon certain groups or cliques as superior to others and make strong efforts to be admitted to these favored circles.

Unquestionably the influence of his associates upon the way the adolescent thinks and acts is very great; greater, probably than at any previous stage of his life. For the adolescent there can be no stronger argument for having or doing a thing than the fact that "all the others are doing it." Nothing is likely to awaken so great an emotional disturbance or cause so much worry as the feeling that he is in some way different from the others. "Others" in this case, means the other members of his own particular group; he is not especially concerned about resembling those belonging to some other clan. A fashion started by the leaders of a group, even though it may happen to be uncomfortable

or inconvenient, is faithfully copied by all the lesser members. Opinions, prejudices, beliefs, likes, and dislikes are likewise determined by the group, and the boy or girl who differs is made to feel the force of group ostracism unless he has sufficient force of personality to bring the others around to his point of view. Mastery, conformity, or exclusion—these are the social alternatives with which the adolescent is faced and no half-way measures are possible. Organizations such as the Scouts, the Campfire Girls, the junior Y.M.C.A. and Y.W.C.A. are doing a good deal to capitalize the group interests of the adolescent and to mold the attitudes of the individual by tactful modifications of the standards of the group.

Gaining Independence

When a little child, the boy or girl is of necessity cared for and protected in the home. He does not have to make very many plans for himself and he gives little thought to the future. But it will not be long, now that he has reached adolescence, before he must leave the home and look after himself. He has to grow up mentally and emotionally as well as physically. And this means a good many changes in habits and points of view. It means breaking old habits as well as learning new ones.

This often is a difficult task both for the adolescent himself and for other people. The boy who has suddenly shot up in height until he is almost as tall as his father looks in the glass and says to himself, "Now I am a man." And he expects people to treat him as a man. But his childish habits still have him in their grip. He borrows his father's neckties and fusses about the crease in his trousers, but he neglects to wash his ears. He wants to drive the family car, but he cannot remember to keep the garage door locked. He spends his allowance for ice-cream and candy and has nothing left for more important needs. He wants to be independent, to

look after himself and manage his own affairs, but his old childish habits of expecting somebody else to take the real responsibility continually get him into trouble. Like Alice in Wonderland he is grown up one minute and the next minute he is a child again.

The adolescent is not the only one who has to form new habits as a result of his growing up. His parents are faced with the same problem. All his life they have been used to watching over him, making decisions for him, demanding obedience from him in little matters as well as in greater ones. Now the time is coming when they must relax their hold in preparation for the time when it must be relinquished completely. This is not easy. It is made more difficult by the fact that there is no hard and fast rule concerning the time when parental control shall come to an end. Although legally a parent's control ceases when the boy or girl comes of age, which in most states is at twenty-one years, many young people are still in college and financially dependent upon their parents at that time, and it is perhaps not unnatural for parents to feel that personal and financial dependence should go together. Even after the child is earning his own living, the old habits of parental dominance may still hold sway. Particularly for the mother whose whole life has been given up to her children is it difficult to let them go and live lives of their own in which she will play a much smaller part.

In certain primitive societies the beginning of adolescence is marked by elaborate ceremonies, the "pubic rites" as they are called because they take place at puberty. After the rites have been performed the child is looked upon as an adult who is no longer subject to parental control but only to the laws of the tribe. Usually there is separation from the parents at this time. The girl is given in marriage; the boy, if he does not marry at once, goes to live with the men. Among civilized people there is no longer anything directly

corresponding to the pubic rites of savage tribes, though there are certain customs that serve something of the same function, such as the society girl's formal debut, the boy's introduction to long trousers, the granting of a latch-key and permission to drive the car. But none of these guarantees to the adolescent complete independence of parental control and for the most part such privileges are not granted until adolescence is drawing near its end.

The conflict between old habits and new requirements—represented on the part of the adolescent by his feeling that he is grown up, that he wants to be treated like a grown-up, while he still has habits of acting like a child, and on the parents' side by their recognition that the child is growing up, their feeling that he ought to act more like a grown-up, although from force of habit they continue to treat him as if he were still a child—often makes for a good deal of friction. This friction can be greatly lessened if both parties realize that they have a definite kind of adjustment to make in which old habits have to be broken up and replaced by new ones. The adolescent has to stop acting like a child and behave like a grown-up. The parent has to stop treating him as a child and permit him adult freedom, responsibilities, and privileges. If each will bear in mind that no habit is overcome all at once and that occasional lapses into the old ways must be expected, much of the irritation that is otherwise likely to result from the fact that the old ways of doing things still crop out now and then, will disappear. A good deal of tolerance is needed on both sides.

Chapter XXI

EDUCATIONAL AND VOCATIONAL GUIDANCE FOR THE ADOLESCENT

How is educational guidance related to vocational guidance?

Why is adolescence a time when guidance is particularly needed?

What kind of special information does the vocational counselor need?

Is superior intelligence always an asset for any kind of job? What part does the intelligence test play in vocational and educational counseling?

Why do general interests such as reading interests, interest in games and sports and the like throw some light on vocational aptitudes?

What are some of the chief hazards in the use of tests of special aptitudes?

What is meant by a "psychological racketeer"? Can you cite any examples from your own experience? How can an uninformed person know what "psychologists" to trust?

Factors Influencing the Choice of Occupations

Before the end of adolescence most young people begin to think seriously about the future and the kind of work they would like to do after they leave school. Of course not all of them will actually enter the occupations which first attract their fancy. Some will be forced into other fields

because they are unable to find an opening in the kind of work they think they would prefer; others will be unable to secure the necessary training; still others will change their minds and decide that they would rather do something else. And even after the first job has been secured, there is likely to be a good deal of later shifting about from one kind of work to another before the individual settles down to a permanent vocation, if he ever does so.

In spite of all this, the vocational plans of the adolescent have decided significance for his future. In most large cities of to-day, high school courses are divided along pre-vocational lines. There are college preparatory courses for the students who plan to enter college, business courses for those who look forward to clerical work, shop courses for those who want to take up one or another of the mechanical trades, courses in domestic science for the girls whose ambitions run along those lines. Thus at the very start of his high school career, that is at the age of fourteen or fifteen, the adolescent and his parents with the help of his teachers or the vocational counselor, if there is one, must make at least a tentative decision about the general kind of work for which he is to prepare. Although this choice is not necessarily final, a good deal of later time and trouble can be saved if it is so wisely made at the start that few readjustments are necessary. Unnecessary changes in plan are likely to be wasteful both of time and money.

All sorts of factors enter into these early choices. Social standing and occupational prestige play a large part. Often a choice is made from very trivial reasons and with very little real information about the requirements of the desired job or the likelihood of securing a position. Stories in books, pictures seen at the movies, the casual advice of poorly informed friends, sometimes, even in these enlightened days, the advice of fortune tellers, astrologers, phrenologists, or palmists may form the basis for the decision. Fathers who

have built up a successful line of business often try to force their sons to follow in their footsteps regardless of the sons' interests or abilities. Less successful ones who feel that their own choice of occupation was a mistake may try to direct their children into some other field, even though the children may show genuine aptitude for the work in which the fathers have failed. Parents who insist that their own unsatisfied ambitions must be gratified through their children are also well known to every vocational counselor. Because Mr. Smith always wanted to be an electrical engineer but couldn't afford the training, his son, John, must take up electrical engineering whether he likes it or not; he *must* like it, his father thinks. And his sister, Mary, must be a nurse, for Mary's mother has never ceased to regret that her parents were unwilling to have her learn nursing and Mary must have the chance that the mother missed.

Educational and Vocational Guidance

Because neither parents nor children are likely to have the amount and kind of information about vocational possibilities that is needed to make a really wise choice as to the training that will be most useful for their children, many schools now employ educational and vocational counselors whose business it is to help the child and his parents to decide what courses he had better take in high school and what kind of work he is likely to be best fitted for. In some cases the counselors also try to help the children to secure positions after they leave school. This work is commonly known as *vocational guidance.* The field is still a new one, and a good deal of experimentation will be needed before we shall be prepared to say just how much can be accomplished in the way of finding out—in advance of actual trial—for what kind of work an individual child is best suited. Personality traits as well as special abilities and level of intelligence have to be considered. But when we stop to

think how children, left to themselves, blunder in and out of jobs for which they are badly suited; when we see how many boys and girls spend their four years in high school preparing to enter college with the expectation of taking up one of the professions afterward, only to find that college work is so far beyond their comprehension that they have to drop out before the end of the freshman year; when we find that many men and women who have been employed for years nevertheless take little pleasure in their work and never seem to make the progress in it which their general ability warrants; when, in short, we see so many square pegs vainly trying to adjust themselves to round holes, a system of guidance which will lessen the number of misfits, even if it does not succeed in correcting all of them, must be regarded as well worth while. To be most effective such a system must begin with the adolescent while he is still in school, when there is still time for him to receive specialized training and before failures from vocational misplacement have dampened his enthusiasm or lowered his self-confidence. The first stage in vocational guidance is educational guidance.

Securing Vocational Information

No one can make a wise choice of vocation unless he knows something about the occupations he is considering. An important part of any vocational guidance program therefore consists in helping young people to secure accurate and up-to-date information about the nature and requirements of different occupations in order that they may be in a better position to decide which ones best fit their interests and capacities.

An analysis of the requirements of a given occupation is by no means the simple, straightforward job that you might think. Among the things that should be found out are the following:

How much education is usually required? Is a special course of training necessary?

For what level of intelligence is the work best suited?

How great are the demands upon physical strength and endurance? Does the occupation involve special hazards to health or liability to accident? Is there anything about it that bars out persons with minor physical defects, such as poor sight or hearing or slight heart trouble?

What special aptitudes such as finger dexterity, understanding of mechanical principles, quick visual perception, and so on are important for success in this occupation?

What type of personality is best suited to this work? What personality traits would make success in it very difficult?

So much on the side of *requirements*. As to desirability, the prospective candidate ought to know not only the immediate rate of pay but the chances for advancement in salary and rank. He should know something about the regularity of the work, whether or not there are seasonal lay-offs. He should know the usual hours of work and what conditions govern overtime work. He should know and be prepared for the unpleasant, fatiguing, monotonous aspects of the job as well as its attractive features.

To secure all this information is not an easy task. It requires a great deal of careful study by persons well trained in psychology and especially in the statistical methods used for handling psychological data. It requires originality and insight in devising methods for studying both the requirements of the different jobs and the characteristics of the persons who are to fill them. It requires both the willingness and the technical skill to subject these methods to careful test in order to find out how well they work and the scientific honesty to discard unsuitable methods, even though they may represent years of patient effort. The field of vocational psychology calls for able minds, disciplined by thorough training. Fondness for giving advice plus a

naïve confidence in one's ability to size up people is not enough.

Intelligence, Education, and Vocational Aptitudes

In Chapter XIV it was pointed out that the average intelligence of persons engaged in the learned professions is distinctly higher than that of persons in most other occupations and that the intelligence of day-laborers, on the average, is excelled by the majority of workers in other fields. Although there are many exceptions to the rule, in a broad sense we may say that the occupations by which people earn their livings form a rough kind of intellectual hierarchy. Certain occupations make high demands upon intelligence, others very little.

A good intelligence test is therefore, within rough limits, a test of vocational aptitude as well. It does not tell exactly what occupation will be most suitable for a given child, but it does limit his field of choice. If his IQ is not high, he will be wiser to plan for an occupation that does not require college training. If it is very low, his chances for success will be greatest in a job that makes little demand upon abstract intelligence and in which he can capitalize any special motor skills or desirable personality traits he may possess. If, on the other hand, he is unusually bright, he will not be likely to find great satisfaction in purely mechanical operations or in jobs that give little opportunity to think and plan. Because such jobs are not interesting to him he may actually not do as well in them as another person of lower intelligence. This is well brought out in an experiment by a certain industrial firm which, in an attempt to pick the "cream" of the applicants for certain routine office jobs, selected only those who stood highest on an intelligence test. It was found that not only was the work of these very intelligent persons of no better quality than that of less able clerks, but more than twice the usual number quit their jobs

within a year. Intelligence is an asset only when it can be profitably used.

An intelligence test taken in connection with the school record then provides the vocational counselor with an excellent starting point for helping the boy and his parents to decide the very important question: What high school course should he take? If his scores are high and he is ambitious to enter college, there is a good deal to be said in favor of a course which will give him the necessary entrance requirements, even though his parents are not financially able to pay all his college expenses. Many able students earn the greater part of their expenses while in college, and there is always the possibility of securing a scholarship. Lack of money need not and should not be allowed to interfere with a child's later chances of happiness and success.

But for the child of less ability, whose interests and talents lie along other than academic lines, it is likely to be as unkind as it is unwise to insist that he shall prepare for college when he receives neither pleasure nor profit from doing so. Far too many students crowd into our colleges and universities each year for no better reason than that "all the fellows are going" or that the family thinks it essential that the son should be known as a "college man." A good many humiliating failures could be saved by more careful selection of college students at an earlier age.

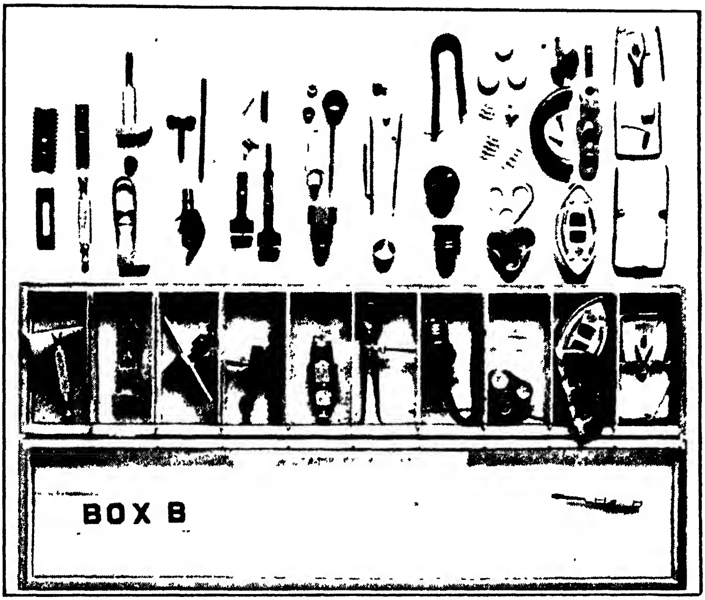
For those who do plan to go to college, the precise choice of occupation can be delayed for a time, though the majority have their minds pretty well made up about it before they finish high school and a fair percentage of these choices will be permanent. For the remainder—those who go to work as soon as they finish high school or perhaps even before—the choice needs to be narrowed down considerably earlier. For them in particular, tests of special aptitude or

trades tests designed to determine their fitness for particular kinds of work are useful.

Aptitude Tests

The ideal test for determining special aptitudes would be a single test, scored in such a way that from it alone one could tell what kind of special abilities the subject possesses. But unfortunately no such test exists. The nearest approach to it is a test of vocational interests devised by Strong after a procedure worked out by Freyd and later by Cowdery. In this test, which was originally designed for college students but which can also be used successfully in the last two years of high school, the subject is required to state his attitude toward a wide variety of different things, ranging all the way from *The Saturday Evening Post* to football, fat men, tennis, Shakspere. The blank is then scored by means of a multiple key and by this method a large number of different ratings are obtained which show how closely his expressed "interests" resemble those of persons successfully engaged in various occupations. For example, it shows whether his interests are most nearly like those of the successful doctor or the successful lawyer or the successful engineer. Although this is not an aptitudes test in the ordinary sense in which the term is used, it does tell something about the line of work for which an individual is likely to be best suited, probably because it gets at some of the "personality" factors which play such a large part in determining success. It is a mistake to think that vocational fitness is wholly a matter of general intelligence plus special talents. Temperament, social adaptability, and emotional stability are quite as important. The latter are very hard to measure, it is true, but that does not excuse us for failing to find out whatever we can about them.

Although there is no single test that measures all kinds of special abilities at once, there are a number of useful



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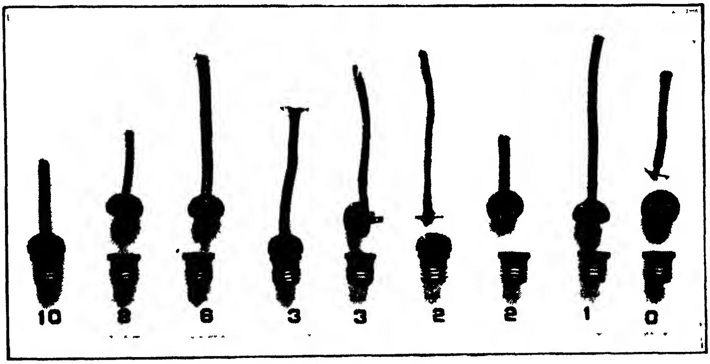

B

FIGURE 71

THE MINNESOTA MECHANICAL ASSEMBLY TEST

A. Materials for the test. B. Method of scoring Item 7 of the test (Courtesy of D. G. Paterson and the University of Minnesota Press.)

tests for measuring certain of them separately. The Minnesota Mechanical Abilities Tests * are among the most carefully worked out. It is interesting to note that the authors of these tests find no evidence for a single kind of mechanical ability, but instead there appear to be a number of broad or group factors (see p. 322) which do not correlate very highly with each other but which, taken separately, are prognostic of ability to succeed in different kinds of mechanical work. The tests have only a low relationship to intelligence, so low, indeed, that a good many feeble-minded boys of high-grade moron level do quite as well with them as the average boy of normal intelligence. But this must not be taken to mean that all the feeble-minded are mechanically inclined. Far from it. On the average they do rather poorly, both in these tests and in actual jobs connected with the mechanical trades. There are individual exceptions, however, and if these exceptions can be found early enough and if the social problems that are likely to arise from their inability to "conduct themselves and their affairs with ordinary prudence" as Tredgold so aptly puts it, can be handled through supervision or otherwise, some of these boys may develop into very satisfactory factory hands.

There are also useful tests for selecting general clerical workers, stenographers and typists, telegraph operators, and workers for many other occupations. Not all of these have been carefully worked out and checked against actual success in the occupations in question. Too often a superficial resemblance between the test and the occupation or even between the test and some minor part of the occupation has been taken as sufficient evidence that the test will prove useful. But if aptitude testing and trades testing have taught us anything at all, it is that appearances are highly decep-

* D. G. Paterson, R. M. Elliott, L. D. Anderson, H. A. Toops and E. Heidbreder, *Minnesota Mechanical Ability Tests* (Minneapolis: University of Minnesota Press, 1930).

tive. Two operations may look almost identical and yet be psychologically so dissimilar that we can tell little or nothing about how well an individual will be able to do the second by trying him out with the first. The vocational counselor must therefore be continually on his guard to avoid being misled by assuming, in the absence of reliable evidence, that a test which is called by a certain name will actually do the work that its name implies. Verification is necessary in every case.

"Psychological Racketeers"

Under this amusing title, Yates * has assembled an amazing collection of authentic accounts of self-styled "psychologists" whose chief talent consists in their ability to fleece the public. Vocational guidance, so-called, is the happy hunting ground of many of these charlatans who take advantage of the fact that most human beings never quite attain their own ideal of success and so are always in a receptive mood towards any scheme that promises to bring them nearer the goal of which they dream. As a result there have sprung up a small army of "character analysts," who for a small initial payment will guarantee to find a whole row of special abilities in even the most incompetent person. More than that! In a short course of only six lessons (which may be taken by correspondence for an additional sum which is really trifling when one thinks of the enormous financial success which lies at the end!) they will show him how to employ these new-found talents in a way that will certainly bring him fame and fortune as soon as the analyst has moved safely on to the next town. Sometimes these persons rely wholly upon a glib tongue, a few unusual phrases that sound as if they might be scientific, and the arts of salesmanship. A few supplement these devices by an

* Dorothy H. Yates, *Psychological Racketeers* (Boston: Badger, 1932), 232 pp.

imposing array of brass instruments with shiny nickel trimmings that can hardly fail to dazzle the unwary. An amusing example of the latter was called to my attention within the last six months. The device consisted of a metal framework, shaped like a cap, with an array of small metal disks, each of which was attached to the outer framework by a flexible spring. This instrument was pressed down firmly over the victim's head. From the degree of compression of the various springs a "skull-map" was prepared which would put the old-time phrenologists to blush. All this for fifty cents! And it is interesting to note that the inventor of this device was reaping a large harvest of half-dollars on the fringes of a meeting of one of our learned societies to which the public was invited.

The psychological racketeer operates in all levels of society. His advertisements, promising success in six lessons, are to be found in the leading magazines read by cultured people and in the "personal" columns of the daily newspaper. Some of the most prosperous travel about from one city to another, advertise themselves on bill-boards, distribute circulars, and hire large halls in which they give courses of lectures that are often attended by large crowds who cheerfully pay the required fees in the belief that now at last they will learn something worth while.

It should hardly be necessary to add that the "get-success-quick" schemes of these peddlers of "practical psychology" belong in much the same class as those of the wily salesman who offers to sell you a beautiful engraved certificate representing ten shares of stock in the Brooklyn Bridge for only fifty dollars. At the best they involve a foolish waste of time and money, and they may do positive harm if the advice they offer is relied upon to the exclusion of other plans which, though less spectacular, have been worked out on the basis of established scientific fact.*

* For the benefit of those who hesitate to trust their own judgment, it

Sound vocational guidance does not claim to work miracles. Because the field is still so new, occasional mistakes are inevitable. But in spite of its youth, vocational guidance in the hands of competent psychologists already has a good deal to offer. As its methods are improved, we may predict that much more can be accomplished than is possible at present.

may be worth while to note that psychologists have their own professional society, the American Psychological Association, membership in which is limited to psychologists with thorough training and of sound professional standing. In cases of doubt it is always possible to ascertain whether or not the person in question is a member of the Association. If he is not a member and is not an impostor, he should be able to name as a reference some member from whom information about his competence for the work he professes to do can be obtained.

Chapter XXII

MOTIVATION OF BEHAVIOR AT THE COLLEGE LEVEL

Why would not every school boy be able to get into college even if he had the necessary funds?

In the elementary school, the children who come from homes of the better class do better work, on the average, than those from poor homes. Does the same rule hold good for college students? Explain.

About what proportion of students who enter college remain to graduate?

What are some of the reasons for failing in college?

What is the literal meaning of motivation?

Does a powerful motive or drive always lead to effective action? Why not?

What is an instinct? What is the attitude of most present-day psychologists toward former theories of instinct?

How do we judge the intensity of a motive? Its clearness? How do purposes differ from motives?

What are the chief ways in which the motives of animals and very young children differ from those of normal adults?

Under what circumstances may a conflict between motives interfere with effective action? Under what conditions may conflicting motives be advantageous?

What is the best way of handling conflicting motives? To what less desirable methods do people sometimes resort?

What is the best sign of a mature personality?

General Characteristics of the College Student

By the time the boy or girl is ready for college, both physical and mental growth are well-nigh completed. Boys gain slowly in height until about the age of twenty, but the total amount of this gain is very small, while the height of girls increases little or not at all after the age of eighteen. Recent studies have suggested that mental growth also continues a little longer, on the average, in boys than in girls, but of this we are less certain.* In both sexes there is usually some gain in weight after growth in height has ceased, and certain bodily measurements, such as depth of chest in both sexes and width of hips in females, continue to increase slightly for many years after the body as a whole has ceased to grow.

Motor abilities of all kinds reach their peak at this age. Interest in athletics and in competitive sports of all kinds is correspondingly high. As a matter of fact, the period from eighteen to twenty-five is the time when practically all abilities reach their highest level. Particularly for the college student, it is likewise the time when serious plans for the future must be made, when childhood is finally left behind, and manhood or womanhood is begun.

If we compare the intelligence of college students with that of all the young people in the country who are of college age, we find, as we might expect, that the students are a very highly selected group. As a matter of fact the further we go up the educational ladder the more persons we shall find whose ability is not equal to the climb and who therefore drop out, leaving only the more able ones to go on the higher levels. Idiots and low-grade imbeciles rarely get into school at all. The higher-grade imbeciles and the morons reach their limits somewhere in the lower grades of the ele-

* See Terman, *Genetic Studies of Genius*, Vol. III, *The Promise of Youth* (Stanford University: Stanford University Press, 1932).

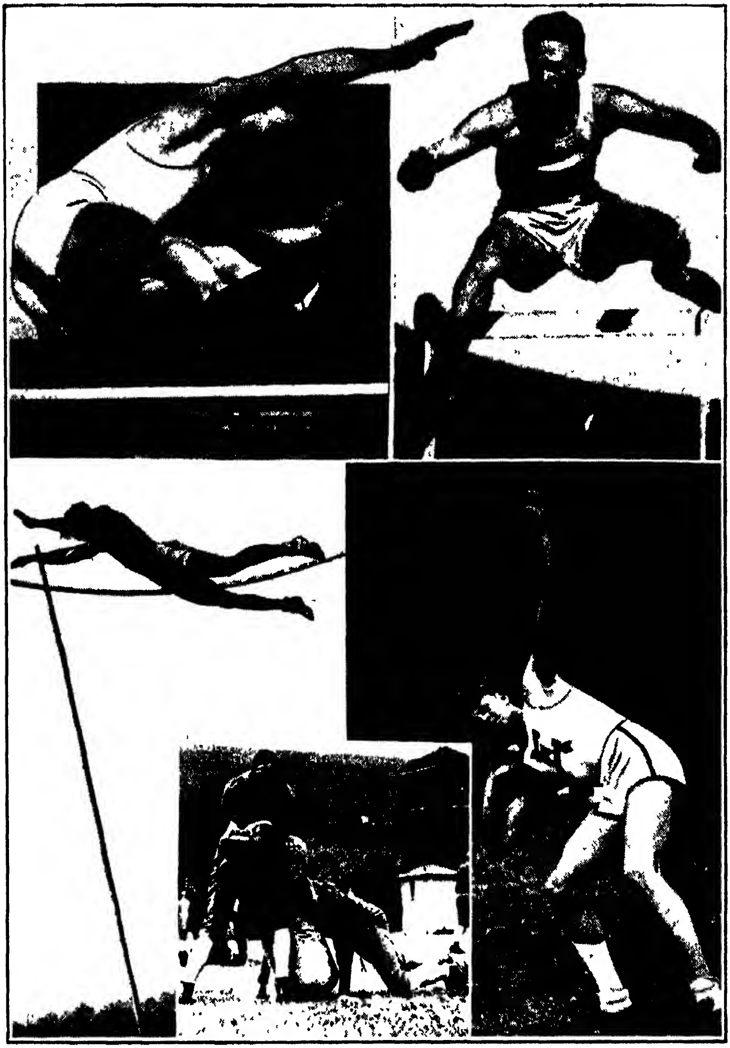

FIGURE 72

SOME MOTOR SKILLS AT THE COLLEGE LEVEL

(Photographs by courtesy of the Minneapolis *Journal* Compare Figures 26 and 56.)

mentary school. Most of the "dull normals" stop with the junior high school, though a few of the more industrious and ambitious struggle on a little further. Very few children whose intelligence is not at least a little above average succeed in graduating from high school (except in the vocational or trades courses), and only a highly selected few complete the college preparatory courses.

Even this repeated sifting is not enough. Most of the leading colleges, in an attempt to reduce the number of failures after entrance, make a further attempt to select for admittance only the really able members of this already select group. In doing this some colleges depend chiefly upon entrance examinations; others take only those who stood in the top half or perhaps the top third of their high school classes, but the majority in determining admissions take into account both the high school record and the performance on entrance examinations (which nowadays usually include an intelligence test). By careful study of the entrance records of students who afterward fail in their college work and comparison of their records with those of the students who succeed, many colleges have succeeded in locating what they call a "critical score" which serves as a dividing line between possible success and almost certain failure. For example, Johnston,* at the University of Minnesota, found that of 208 students who entered the freshman class with scores below the critical point, all except three had failed before the end of their first year. But of the students whose scores were above this point, 42 per cent also failed. The critical score predicts failure very well because it selects the students who cannot do the work even though they try. But it is less accurate in predicting success because some who could succeed will not make the necessary effort to do so.

* J. B. Johnston. The study of student aptitude for college work as a means of educational guidance (University of Minnesota Faculty Bulletin, 1927), Vol. I, No. 1, 4 pp.

However, it seems reasonably safe either to refuse outright to admit students whose scores are so low that failure seems almost certain or at least to advise them strongly to turn their interests in some other direction.

Through all these successive eliminations of the less able members of the group, it comes about that the great mass of college students are recruited from the upper ten per cent of the intellectual distribution. Those who remain to graduate form a still more highly selected group, and as a rule only the best of the graduates become candidates for higher degrees.

The greater number of college students come from better than average homes. In part this is because of the relationship between socio-economic status and intelligence. But if a college professor or a doctor has a son with an IQ of 140, the chance that this boy will be sent to college is far greater than that the equally brilliant son of a day laborer will be given the same opportunity. Although college students come from all ranks of society, the proportion coming from cultured homes is much greater than chance alone would lead one to expect. But—and this may seem strange until you stop to think about it—among those who do succeed in getting into college, there is little or no relationship between the cultural level of the home and college success. Indeed a few studies have shown a small tendency in the opposite direction, students from the poorest homes doing on the average a little better work than those from the best homes and vice versa. There are two reasons why such a reverse tendency may exist. The first is that the students from the poorer homes are more highly selected than those from the better homes. Since college is not a social tradition with these groups, parents are not likely to think of providing college training for their children unless they show very decided ability. But in the upper social classes, where going to college is pretty much the accepted

thing, almost any youth who is not an absolute dunce will be entered, if family influence and special tutoring can do it. Moreover, the student whose family has made a great many sacrifices in order to send him to college is likely to make a greater effort to do his best than the one who takes his opportunity to be sent to college for granted.

How Many Students Graduate?

The answer to this question will vary with the college. Some colleges have high standards for graduation but open their doors freely to all applicants for admission who bring the necessary credentials from accredited high schools. Their student mortality rate is high; perhaps not more than one freshman out of five ever succeeds in getting his degree. Others having equally high standards do more weeding out at the start with the result that, of those who succeed in getting in, the majority remain to graduate. If the standards for graduation are lowered, more students will of course be able to get through, and as a matter of fact students who fail in one college not infrequently succeed in getting diplomas from another where the requirements are not so severe. A good many, too, who find their class work a little more than they can manage if they attempt to move along at the usual rate, find a solution for their difficulties by taking more than the usual four years to complete the college requirements. Students who are partially self-supporting are likely to find this desirable. The idea that most students succeed in getting through college in four years' time, if they do so at all, is a mistake. West * found that of 1,672 students who entered the University of Minnesota as freshmen in 1920, only 23.7 per cent—less than one in four—obtained their diplomas within four years. However, an

* R. M. West, "Student Survival," *Bulletin of the University of Minnesota* (1925), 50 pp.; "Evaluation of Interruptions in College Attendance," *loc. cit.* (1929), 27 pp.

analysis of the graduating classes at Minnesota and elsewhere, which was made in order to find out what proportion of the total number of degrees was granted to students who had taken more than four years to complete their college work, led him to estimate that in the course of time, approximately 52 per cent would succeed in graduating. Edgerton and Toops * who conducted a similar study at Ohio State University obtained somewhat lower figures. They found that, of 1,958 freshman studied, 18.1 per cent graduated within four years. It was estimated that about 34 per cent would ultimately do so. Although the exact percentages will vary from one university to another, all available reports show that a large proportion of students requires more than the traditional four-year period in order to graduate.

From these and many other studies dealing with college success it is evident that students vary greatly in the extent to which they succeed in their studies. Some fail miserably and sooner or later drop out; some succeed by taking more than the allotted time; others make brilliant records and graduate with high honors.

Factors Contributing to Success or Failure

In trying to account for these differences we naturally think first of the question of intelligence which we found so important in determining school success among younger children. In college, too, differences in the intelligence of the students account in part for the differences in their academic accomplishment, but non-intellectual factors likewise have a good deal to do with it.

Differences in early preparation play a part. Particularly when they first enter college, students whose high school preparation has been poor are at a disadvantage as compared to their classmates. But if they are intelligent and

* H. A. Edgerton and H. A. Toops, "Academic Progress," *Ohio State University Studies. Contribution in Administration*, No. 1 (1929), 150 pp.

industrious this can be overcome. The most serious educational handicap found among college students consists in faulty reading habits. Students who read slowly, haltingly, who have to form the words with their lips in order to get the sense of what they read find it hard to complete their college assignments in time. Inadequate vocabularies handicap many. Ignorance of the fundamental laws of English composition, together with inability to spell or to punctuate, are responsible for many low grades on term papers that may be excellent in other respects. Difficulties of this kind can usually be corrected if special attention is given to them.

Poor health accounts for some failures and for a good many cases of delayed progress. Defective sight or hearing, sometimes unrecognized by the student himself may cause difficulty. Financial conditions that make it necessary for some students to earn all or part of their expenses impose further strain, particularly with over-ambitious students who insist upon carrying too heavy a load of class work along with their outside jobs and who pay the penalty in broken health or low marks.

But although all these things are significant, the fact remains that there are many students of good intelligence and excellent health, not handicapped by lack of funds, who nevertheless fail in their courses, while there are others of less ability who do good work in spite of adverse conditions. Although many factors contribute to these differences in achievement, two are of outstanding importance: differences in study habits and differences in motivation.

On the basis of his experience in conducting "How to Study" courses, at the University of Minnesota, Bird * has made a valuable analysis of the factors that interfere with effective study and has pointed out a number of ways for

* Charles Bird, *Effective Study Habits* (New York: The Century Co., 1931), xx + 247.

improving study habits. He stresses particularly the need of apportioning one's time among the various college activities in such a way that significant matters will not be crowded out by devoting too much time to trivialities. He notes the importance of providing a favorable environment for study. He suggests methods for getting the most out of the time spent in study, tells how to read effectively, how to take reading and lecture notes. There is a chapter on taking examinations and one on writing themes. Students who have reason to think that their habits of study are open to improvement (and who is there to whom this does not apply?) will find much that is helpful in this little volume.

But knowing how to study does not count for much unless the knowledge is put into practice. Arousing the desire to study, getting the studying started, and keeping it up until the work is done is the really important thing. The same principle holds good with everything else in life. It is activity that counts. The question is: How can activity be aroused and directed toward accomplishing useful results? This process is known as motivation and because it is of such great importance, not only in determining success in college but throughout the whole period of life, it merits careful attention. Although in previous chapters we have frequently had occasion to mention this factor, we have not discussed it in much detail. Before we attempt to show how differences in motivation affect social and scholastic success it will be worth our while to make a brief digression in order to get a clearer idea of what motivation is, how it operates, and how the motivation of adults differs from that of children.

What Is Motivation?

The literal meaning of *motivation* is the process of inducing movement. A motive or, as it is often called, a "drive" is something that arouses an organism to action. Of course

by "action" we do not mean just the movements of the muscles, which, as we have pointed out before, are only the later stages in activity. All actions begin with some kind of intra-organic change, which the outsider is unable to observe. Motivating an individual means getting him to do something. This "something" may involve muscular activity; it may be just sitting still and thinking. People are motivated to do a great many different things—to read, to study their lessons, to play football, to go to parties, to make love, to write novels, to hoe corn, or to dig ditches. But the motive which lies back of all these diverse activities is, in a sense, the same. People are motivated—that is, they are induced to do things—because they are not entirely satisfied with their present condition. If this state of dissatisfaction becomes strong enough to overcome their inertia they do something to bring about a change. The particular thing that they may do depends, first of all, upon their abilities and accomplishments and secondly upon what experience has taught them is most likely to relieve their dissatisfaction, or to bring about a state of greater satisfaction. The first step in motivation is then the arousal of an organic state that is not entirely satisfying. Such a state in itself, if it is sufficiently pronounced, will induce a kind of general activity or restlessness, but in order to change this undirected activity into a definitely organized pattern that will lead to useful accomplishment it has to be directed toward an end or goal. The real goal, of course, is a return to a state of satisfaction; but the immediate goal toward which the individual directs his striving is something that nature and experience, acting together, have taught him is likely to bring about such a state.

Consider a few examples: A healthy young cat has been given no food for several hours. At the end of that time he is put into a cage, the door of which is closed by a simple contrivance such as a button that he can turn with his paw

or a loose strap that he can pull off its fastening. A piece of fish is put outside the door where the cat can see and smell it.

Before we observe the cat's behavior let us look at the conditions. First of all, the cat's organic state is not one of complete satisfaction. He is hungry. This, alone, is enough to make him restless as every one knows who has observed a hungry animal. But just outside the cage is something that would satisfy his hunger, something, moreover that is particularly pleasing to a cat's appetite. So, naturally enough, he tries to get it. He claws at the bars of the cage, scrambles about more or less, but always directs most of his struggles against the part of the cage that lies directly between himself and the fish. This is not purely random activity; from the beginning it is aimed at attaining a given end and so takes on a particular direction and a pattern that varies only within certain limits. The cat jumps, claws, perhaps bites at the bars, occasionally stops and runs about the cage, but for the most part he keeps his head and body turned toward the fish. He may mew, but he does not purr; neither is he likely to chase his tail, to sit down quietly and wash his face, or to show a good many other forms of behavior that young cats often do exhibit under other circumstances.

Put the same cat, in the same state of hunger, into the cage on another occasion, but this time put no food outside. Again the cat runs about and claws at the cage but less violently. He does not select any one part of the cage toward which to direct his efforts, but roams about restlessly, now here, now there, stopping sometimes to stand with his paws against the bars, watching the experimenter, or to lick his fur for a minute or two, after which he resumes his restless wandering. His behavior is more varied, less predictable, and far less vigorous than it was on the first occasion. Most of all, it lacks apparent direction.

Now give the cat all the fish he will eat. Then put him in the cage again with another piece of fish outside the door as before. The chances are he will pay no attention to it. Probably he will lie down and go to sleep.

Try one more experiment. Put the cat into the cage but instead of a piece of fish, place a piece of apple outside the door. What will the cat do this time?

If he is hungry, he will probably act much as he did on the second occasion. He will roam around, perhaps claw at the bars occasionally, but he will not pay any particular attention to the apple, which for him is not food. His state of hunger keeps him moving around, but his activity is undirected. If he is not hungry, he will probably be less restless, but he will still pay no special attention to the apple.

These experiments illustrate a number of factors in human and animal behavior. The hungry cat, because of its unsatisfied organic state, behaves differently from the cat that has just had all it can eat. And the hungry cat that sees a means of satisfying its hunger behaves differently from the hungry cat when no food is in sight. Furthermore, the cat that not only perceives the goal but has learned by experience how to get to it—that has learned, for example, how to turn the button or to pull the strap by which the door may be opened—behaves differently from the one that is equally hungry, and that sees the fish equally well but for whom the button or the strap has as yet no meaning. All along the road leading to the final goal—satisfaction—are objects that eventually, as the route is learned, take on the character of semaphores or guide-boards, showing the individual that he is on the right track. In this instance as in many others, learning to read these semaphores and to respond to them proceeds for the most part in a backward direction from the goal. First the goal itself is perceived as such; later the button or the strap comes to be singled out

and responded to in a fumbling, hap-hazard fashion; still later the particular movements—turning the button or pulling the strap—are learned with more or less exactness.

In the process of motivating behavior effectively we may then distinguish three general stages. First there is the organic state, secondly the recognition of the goal, and finally the gradual emergence of intermediate goals that act as signals to mark the way. Often, though not always, these intermediate goals appear first as obstacles. But, if the individual learns that these obstacles lie on the road to successful attainment of the goal, they may come to be hailed with delight not because they are obstacles but because they have now taken on a more important meaning as signals. If you are anxious to get home you may welcome the sight of a particularly bad bit of road ahead of you if it means that you are nearly there. People spend many unpleasant hours with doctors and dentists for the sake of the better physical condition which they hope lies beyond. They labor hard at uncongenial tasks for the sake of some later reward.

One further point. Human beings certainly and probably animals as well find satisfaction merely in overcoming obstacles. Just being alive and awake is an organic state that induces a healthy person to seek further satisfaction in activity. Moreover, the body seems to be so constituted that when obstruction is encountered an extra store of energy is released. If you push against the sole of a baby's foot, his leg muscles stiffen. If you try to read extremely fine print the eye-muscles that focus the lens become tense, giving a sensation of strain. These are local reflexes, appearing chiefly in the part of the body at which the obstruction is felt. The bodily response to a felt obstruction is an increased expenditure of energy, which is mainly directed into that part of the organism where there is need for it. A difficult problem in calculus makes you think harder than you do in adding $3 + 5$; a fifty pound weight causes you to put

forth more muscular effort in lifting than one of three or four ounces. The knowledge that one has met with obstruction seems to introduce a further organic change, an increased mental and muscular tension that is pleasurably relieved when the obstacle is overcome.

The reaction to obstacles then consists of a preparatory organic change, in which there is increased release of energy for making the attack. If the attack is successful, there is a later sense of gratification because the difficulty has been overcome. Woodworth classifies this reaction as the *mastery motive*. The desire for mastery and the satisfaction that results from it are undoubtedly very strong among human beings, particularly when the obstacle to be overcome lies in the way of some further desire. We enjoy testing our abilities just for the satisfaction of finding that they are equal to the test, but the joy is keener and more lasting, if, in addition to the mastery of the obstacle itself, we are able to point to it as a signal that we have come so much further along the road to some major goal. The golfer on the practice green may get a good deal of satisfaction from accomplishing a particularly difficult shot, but in a real game it would mean much more to him. Mastery alone is a powerful motive, but mastery for a purpose is a greater one.

Classifying Motives

If we think of motives as having their start in organic states that are not entirely satisfying, it is evident that the number of such states is legion. Some, like hunger and sex desire, are experienced at times by nearly all living creatures. Some, like the desire for mastery or the desire to explore and manipulate the things in one's environment, seem to vary greatly in strength with different individuals. Whether or not this difference is wholly due to experience we do not know. Some motives, such as fondness for reading, are restricted to human beings; others, such as the unknown

urge that starts the migratory flight of birds, are confined to other species.

The difficulty in trying to classify motives according to kind lies in the fact that the nature of the organic states cannot in most cases be observed directly but has to be inferred from the activities to which they give rise and the goals toward which they tend. Sometimes the inference can be made with a good deal of assurance. If an animal that has had no food for some time goes wandering restlessly about, uttering cries and nosing about in every place where it has been accustomed to finding food, we are pretty safe in assuming that it is hungry; and, if, on being shown food, the animal makes for it with all its might, we feel that the assumption is satisfactorily verified. But the motive that causes birds to migrate is still a matter of controversy. If it is the growing scarcity of food, why do some birds migrate, while others, whose food habits are much the same, remain in the north all winter? If it is a matter of temperature, why do some species continue their flights not merely to warmer climates but across the equator?

Earlier psychologists often cited great numbers of acts which were presumed to be due to "original nature" or "instinct" and so required no further investigation. More recently the pendulum has swung in the other direction. The term *instinct* had been made to cover such an astounding multitude of scientific sins that a challenge was inevitable, and this challenge took the form of denying or at least of expressing grave doubt about the very existence of behavior that is wholly unlearned. Even the classic examples of so-called "instinctive" behavior in animals, such as the songs of birds and the mouse-catching habits of kittens, were put under the search-light of the laboratory and were found to be much less fixed and invariable, much more subject to modification through experience than had formerly been supposed.

Consider these examples: Hunger and the sex urge are such universally effective motives in all animals, including man, that we need have no hesitation in saying that to a great extent they are unlearned. But we do learn to recognize and understand them and to delay gratifying them except under certain conditions. And the particular ways in which they are gratified are determined to a great extent by social custom, by experience leading to the formation of individual likes and dislikes, and so on. So learning plays a part even in such "instinctive" tendencies as these.

Fondness for reading may seem at first thought to be wholly learned. But what about the matter of curiosity, of wanting to find out things, which seems to be one of the most dependable of human motives, if we may judge from the universality of children's questions? And what about the vicarious gratification of emotional and social urges by identifying oneself with the characters in a story, which is unquestionably one of the satisfactions that many people get by reading? Can we be sure that the desire for reading is wholly acquired?

Even if all the facts were known—and most of them are not—it would still be very difficult to decide whether to classify a given motive as *chiefly* instinctive or *chiefly* learned, admitting that both factors are operative. The difficulty lies in deciding to which of a number of conflicting lines of evidence we shall give most weight. What, for example, shall we say of the fact that most civilized persons will die of hunger before attempting to eat each other, while some savage tribes take to cannibalism even when there is no great scarcity of food? Maternal love is a powerful motive in both humans and animals, at least for a certain time after the baby is born. The ferocity of the mother bear in protecting her cubs, the vigorous attack of the mother hen when a stranger threatens to invade her nest are well known. Most of us can cite examples of greater or smaller acts of

self-sacrifice and heroism on the part of human mothers in protecting their babies from harm. But what of the unmarried mother, fearful of social disgrace, who drops her baby into the rubbish can at the street corner or who leaves it unprotected in an open hallway on a winter's night?

One might go on multiplying examples indefinitely if it seemed worth while to do so, but the foregoing should be sufficient to illustrate the hazards that arise from any arbitrary method of classifying motives on the basis of their learned or unlearned elements. The important thing is that motives exist and that they incite to activity. But the same motive will not always lead to the same kind of activity in different persons nor produce like activity in the same person at different times. Conversely, we cannot always tell from an individual's behavior by what motive he is activated. Even the individual himself may not know, as we shall see later. As a more profitable way of looking at the matter, let us try to see if there are any fairly general qualities, common to all or to most motives, that will help us in our descriptions. Immediately we think of three characteristics—following the fashion set by Wundt and later by Boring * we might even call them "dimensions"—the in-

* William Wundt, one of the greatest of German psychologists, under whom a large number of the early American psychologists received their training, proposed a "tri-dimensional" theory of feeling (often extended to include emotions as well), which he hoped would enable one to give a complete account of the psychological dimensions of a feeling just as we state the dimensions of a rectangular solid in terms of its height, breadth, and thickness. According to Wundt, feelings vary in one dimension along a scale running from unpleasantness at one end up to pleasantness at the other, with a neutral zone in the middle. The second dimension has excitement—the greatest state of excitement imaginable—at one extreme, and numbness or depression at the other extreme, with varying degrees of excitement or its lack in between. The third dimension runs from tenseness to release or relaxation. A good many persons have objected to Wundt's scheme both on the grounds that it is incomplete, that feelings have other dimensions or qualities that are equally important (Woodworth in his *Psychology* mentions as examples, desire-aversion and familiarity-strangeness), and on the grounds that in the two dimensions last

tensity or force of the motive, its clearness, and the remoteness of its goal. With less certainty we might add a factor that might be called *polarity*—depending upon whether the motive is a state of discomfort from which the individual tries to obtain relief, or whether, from an already comfortable state, he catches a glimpse of something that means (so he thinks) even greater satisfaction and is thereby thrown once more into a state of activity. This last distinction is questionable, yet there does seem to be a difference between eating to satisfy hunger and continuing to eat long after the hunger is satisfied because food is offered that makes a special appeal to the palate. So also there seems to be a difference between reading a book from choice and reading the same book for fear of failing in an examination. It is unlikely that the catalogue of qualities or dimensions given here includes all that we need to know about motives, but it does provide us with a useful starting point for description and analysis.

The First Dimension—Intensity or Force of the Motive

That motives differ in the intensity of the reactions they arouse is a matter of common observation. A cat that is

named the extremes cited are not true opposites of each other. In spite of these imperfections the scheme is an interesting one, for it suggests a method by which the qualities of feelings can be compared with each other, even though the feelings themselves lie in different classes.

Boring makes use of a similar scheme in *The Physical Dimensions of Consciousness* (The Century Co., 1932). Proceeding upon an idea that seems to have originated with Wundt and was further developed by Titchener who, of all American psychologists, was most strongly dominated by the Wundtian tradition, Boring suggests the following as the "dimensions" of consciousness: quality, intensity, extensity, and protensity. Quality refers to such differences as color or the pitch of tones. Intensity has to do with strength or vividness. Extensity refers to differences in size or extension in space, qualities that are most easily perceived by the senses of vision and touch. Protensity refers to time qualities. Titchener added to these a fifth quality, that of clearness or attensity (from attention), but Boring regards this as unnecessary. As we have used the term, clearness of motive is not entirely a function of attention but is to a great extent dependent upon understanding.

very hungry will respond to food much more vigorously than one that is just barely beginning to develop an appetite after its last meal, and it will be more restless and irritable when no food is in sight. A child who is badly frightened will display much more violent behavior than one who is only slightly shy or who finds himself in an unfamiliar situation to which he is not quite certain how he ought to respond. A student who is trying to make the football or the basketball team works harder over his athletics than one who takes physical education only because it is required.

We judge the intensity of the motive by the vigor and force of the activity that it arouses. Perhaps this is not always a fair criterion, but it is the only one we have. Up to a certain limit, there is likely to be a fairly close relationship between the amount of energy expended and the amount of work accomplished, but a very intense motive may arouse a frenzied, disruptive state of activity that exhausts without accomplishment. To return to our old example of the caged cat—if the animal is put into the cage when he is not hungry, he will not scratch and claw at the door when fish is put outside. The door will remain closed, and the cat will accomplish nothing in the way of learning how to open it. But if he is almost starved, the sight and odor of the fish may throw him into such a state of frenzied excitement that he claws all over the cage and does not seem to learn very much, even if he does succeed in getting the door open. He will learn most rapidly, if he is hungry enough to have the sight of the fish arouse a strong and vigorous attack on the door but not so hungry that his behavior loses all coherence and order. Likewise the student who is strongly motivated by a desire to succeed in his work will usually do better than the one who is indifferent, but if the motive becomes too intense, it may get out of hand with the result that the student becomes flustered, excited, worried, is un-

able to collect his thoughts or direct his attention, and says with truth that "the harder he works the less he knows."

If I were to ask a dozen college students at what point in their studies this condition is most likely to arise, it is probable that more than half of them would answer at once, "Just before examinations!" This brings us to the phenomenon of the "end spurt," which is so often noted in studies of work and fatigue. When the runner is nearing the goal, he gathers his strength for one last mighty effort and his speed increases in spite of his growing fatigue. Factory workers employed on piece-work usually show an increase in output just before closing time. The student crams for examinations because he knows it is now or never. The sight of the goal, the awareness that the end is near, seems with many persons to have the effect of releasing a greater store of energy. The individual works harder, and in most cases he accomplishes more. But if the sight of the goal has as its chief effect the arousal of a fear of failure, then the disruptive effect described is particularly likely to occur. Fear is a powerful motive of which a very little goes a long way. A large dose is likely to be disastrous.

The Second Dimension—Clearness

The hunger motive plays as large a part in arousing a baby or an animal to activity as it does in a grown man, but it operates differently. From his past experience in similar situations a man usually knows what is the matter with him when, around lunch time, he begins to find himself growing restless and irritable. "Better get something to eat," he tells himself, and off he goes. But the baby, if no food is in sight, has no such clear understanding of his difficulty. He cries and frets, he fidgets about, but it takes the actual sight or, if he is very young, the actual taste of food to change his general restlessness and irritability into a clear-

cut reaction pattern leading directly toward the goal of food-getting.

Motives vary in clearness as well as in strength. We have said that we judge the intensity of a motive by the vigor of the reactions it arouses. We judge its clearness by the character of these reactions, by the cutting out of random movements, by the taking on of a definite pattern which runs toward a definite goal. Instead of scattering his energy aimlessly in all directions the individual seems to converge his efforts toward a certain point.

The actual perception of the goal affects the clearness as well as the intensity of a motive. It seems to focus it, often suddenly and sharply. Contrast the behavior of the hungry cat when no food is in sight with its behavior when food is seen and smelled. Random activity ceases at once, and all its struggles are directed toward getting the food. Or compare the behavior of a white rat the first time he is put into a maze with his behavior after the maze has been learned. At first the maze means nothing to him but a strange place which the hunger motive drives him to explore in a random and undirected fashion. Later on it comes to mean a place leading to a goal where food can be found, and he makes for that goal with all his might. A motive is clear in proportion as some specific goal is perceived or foreseen.

According to their degree of clearness, motives may then lead either to activity that is formless, vague, without clear-cut pattern and relatively ineffective or to particular kinds of activity with most of the random movements eliminated. In the latter case we say with some justification that the individual knows what he wants. He may have difficulty in getting it. He may not choose the method that to you or me seems wisest. He may meet with obstructions, go through a lot of waste movements, and expend a great deal of energy fruitlessly before attaining success, or he may even fail to succeed at all. But, while his movements may be ineffective,

they can hardly be described as "random." They are directed toward the goal, though they may be poor ways of getting there.

How Purposes Differ from Motives *

A motive so clear that the individual knows what he wants to do and something, at least, about how he means to do it is often called a purpose. In human beings a purpose can usually be put into words, and this constitutes a rough way of distinguishing between motives which are vague and unanalyzed, leading to activity that is poorly adapted to accomplishing useful results, and purposes which are by comparison clear-cut, leading to effective action. Of course there is no sharp distinction between the two, for motives gradually crystallize into purposes, and purposes as well as motives vary in clearness and in the definiteness of resulting action. But the verbal test gives us some idea about where to draw the line.

Purposes differ from motives in another way. All along, in our discussions of intelligence, we have pointed out how greatly the use of symbols facilitates intelligent action. When we put our motives into words, what we have really done is to reduce them to symbols by means of which we can plan our actions in advance as an architect works out the design of his house on paper before actually building it up in brick and stone. As long as he sticks to his paper, it is an easy matter to modify his design, to compare one plan with another, to correct errors and supply omissions. Once the building is under way, it is a different matter, for mistakes made then are difficult and costly to correct. As long as we are governed solely by motives which we cannot understand or refuse to recognize, we are not likely to get full value for our labor. We may work just as hard or

* For an extremely stimulating discussion of purposive action, the student should consult E. C. Tolman, *Purposive Behavior in Animals and Men* (The Century Co., 1931).

harder, we may stick to it as long, but we are like the builder without a plan who may toil long hours in the heat of the day, carry heavy loads, exhaust himself and his resources, without getting much of a house in the end.

Do animals show purposive action? The answer to this question obviously depends to a large extent upon our definition. If we draw the line between motives and purposes at the point of verbalization and refuse to admit the existence of a purpose that cannot be expressed in words, then we need have no hesitation in saying that animals are activated only by motives, that they have no purposes. But there is an intermediate condition. When food is placed just outside the bars of a cage, the behavior of the cat inside is certainly directed toward a very definite end as anybody can see, even if the cat himself is not able to tell about it in words. Such behavior has in it some but not all of the characteristics of what in man we call purposive action. It resembles purposive action in its direct attack upon the end to be obtained which leaves neither the observer, nor, it is safe to assume, the animal himself in much doubt as to what that end is. If a hungry human being is put into a cage with a fastening which is as hard for him to open as the one used on the cat's cage is for the cat, the human's behavior may not differ greatly from that of the animal. Certainly it will involve a good deal of ineffective activity at the concrete trial-and-error level. Except for the single matter of speech, animal behavior looks to the outsider to be about as "purposeful" as human behavior when the goal or something that stands for the goal is actually in sight. But without the immediate stimulus of an objective that can be seen, smelled, felt, heard, or tasted, animal behavior gives little evidence of anything that can be regarded as purpose. The normal intelligent adult, on the contrary, forms many of his purposes when no concrete stimulus is present. He lies in bed at night, and, in spite of darkness and silence,

he maps out what he is going to do the next day, the next year or, projecting his purposes still farther into the future, he plans for the life and professional career of his infant son. Unknown to any one but himself he carries these uncompleted purposes about him, remodeling them from time to time, correcting their imperfections, always waiting for the appointed time for putting them into action.

The Third Dimension—Nearness or Remoteness of the Goal as Illustrated by the Delayed Reaction Experiment

Are animals capable of planning their activities in advance and then waiting for an appropriate time to elapse before carrying them out? As to the planning, we can, of course, have no very direct evidence because we cannot know what goes on inside the animal, and his behavior alone does not tell us what schemes he may be harboring that he is not at the moment carrying out. But we can get at the matter in another way, for, if we find that an animal can only respond to a signal when it is actually present and that he loses all track of it as soon as it is removed or a few seconds afterward, it would strain our credulity to assume that he could plan out a whole course of action with no signals to guide him at any time.

The delayed reaction experiment is designed to test this point. First the animal is trained to respond to a simple signal of some kind. He is placed before a box that has two doors exactly alike except for one thing that is to serve as the signal. Perhaps one door has a light burning above it. Behind the lighted door is food; the other door leads only into an empty space or, in some experiments, an electric grill is placed behind the unmarked door so that the animal gets a slight shock if he makes a wrong choice. The signal is changed about irregularly. Sometimes it is on the right, sometimes on the left, but always it marks the door behind which

the food is to be found. After a period of training most of the higher animals such as rats, cats, dogs, or monkeys will learn to look for the signal and run directly to that door, paying no attention to the other. But suppose that, after an animal has the signal so thoroughly learned that he makes no mistakes but picks out the right door unerringly as long as the signal can be seen, he is prevented from going to it at once and during the delay the light is turned out. Will he be able to "remember" the right door and go there to get the food as soon as he is released or is his ability to respond dependent upon the actual presence of the signal?

Hunter,* who made one of the earliest and most extensive studies of the delayed reaction, found that most animals that are able to learn to respond to a signal will continue to respond correctly after a brief delay. With rats the maximum is about five seconds. Unless the act can be carried out within that time it cannot be done at all. Cats can wait a little longer, perhaps a quarter of a minute; raccoons and dogs still longer and children longer still, the exact time depending on the age of the child. Hunter's figures for children are not very reliable because of his few cases, but Skalet,† who conducted a similar experiment with larger groups, found that even after several days had passed, children of two to four years could select the one of three plates under which they had previously seen the experimenter put an animal cracker. She also found that the length of delay after which a correct response could be made varied with the kind of stimulus used. The more concrete and meaningful the situation, the longer was the possible delay. Children would respond to the animal cracker situation after a longer delay than was possible when the task was to select the right one of three pictures of common

* W. S. Hunter, "The Delayed Reaction in Animals and Children," *Behavior Monog.*, 1913, 2: 1-86.

† Magda Skalet, "The Significance of Delayed Reactions in Young Children," *Comp. Psychol. Monog.*, 1931, 7, 82 pp.

objects; and the picture situation, in its turn, permitted a longer delay than was possible when meaningless geometrical figures were used. Tinklepaugh,* with monkeys as subjects, used a plan similar to Skalet's first experiment. He would put lettuce or banana under one or the other of two inverted cups while the monkey looked on. The monkeys, like the children, were able to respond correctly after a considerable delay, in some cases after several hours. This is not equal to the performance of the children, but it is far better than any of the other animals that have been studied were able to do.

In addition to the time over which the reaction could be delayed without interfering with the response, Hunter noticed † another point. The less intelligent animals usually have to keep their eyes, heads, and bodies turned in the right direction all through the period of the delay. If the bodily orientation is lost the response cannot take place. But with the children, the monkeys, and some of the dogs and raccoons a change of position during the period of delay makes little or no difference. The children and the monkeys can even leave the room, go on with their regular occupations, and still respond correctly on their return, provided the interval is not too long.

The delayed reaction experiment affords another example of the differences between animals and human beings in respect to the factors that arouse and direct their activities. It also illustrates our third dimension, the nearness or the remoteness of the goal to which a subject can respond. Animals and very young children respond chiefly to the goals that they perceive at the moment, and, if these goals which

* O. L. Tinklepaugh, "An Experimental Study of Representative Factors in Monkeys," *J. Comp. Psychol.*, 1928, 8: 197-236.

† More recent experiments suggest that bodily orientation toward the goal is not an absolute requirement for success, even in the case of rats but if bodily orientation is lost the reaction cannot be delayed for as long a time.

serve as the immediate stimuli are removed, the behavior soon loses its aim and reverts once more to its previous state of comparatively formless activity.* With slightly older children and adults a considerable period of time can elapse from the time the individual first "gets set" to react in a particular way and the actual carrying out of the reaction. It is tempting to speculate about what this difference means in terms of nerve physiology. Since we do not know, about all we can say at present is that whatever the change in the organism that comes about as a result of this process of "getting set to respond in a particular way" may be, some animals maintain this state for long periods of time, while others revert to their previous condition almost as soon as the stimulus is removed, much as certain unstable chemical compounds break up as soon as the limited conditions under which they can be formed are changed, while other more stable compounds remain unaffected by a wide variety of circumstances.

Conflicting Motives

All of you have had the experience of being obliged to choose between two actions, only one of which could be carried out. What usually happens in these cases is that you hesitate for a time, comparing the advantages on each side until one becomes dominant over the other and the choice is made.

Suppose the problem is that of deciding on your life work. After a little consideration the choice usually narrows itself down to two or three alternatives for which the relative advantages and disadvantages seem so equally balanced

* *Formless* as used here means unpredictable. The animal that is no longer orientated toward a particular goal responds now to this stimulus in his immediate neighborhood, now to that, but until he finds something that satisfies the organic need that aroused him to activity in the first place he does not stick long to any one thing. *Random* activity really means constantly shifting activity.

that the decision becomes very difficult. As far as you or your vocational counselors can find out, you are about as well fitted for one as for the other. The training requires about the same length of time in each case, but, since it differs in kind, preparation for the one occupation would not fit you to enter the other. The choice has to be made in advance. You compare the probable number of openings in each field, the usual rate of advancement, the financial reward, the attractiveness of the work, and so on. Finally you make a choice. And now comes an interesting point—if you are a normal, healthy-minded person, the very fact that your choice has been made adds tremendous weight to the side on which the choice fell. In addition to all its original points of desirability, the occupation chosen is now *your* occupation. It is a part of yourself, of your own personality, and so you naturally see its good points, and the disadvantages that occurred to you in the beginning fade into insignificance. This is as it should be.

But you have all met persons whose choices rarely seem to work out that way. When forced to make a decision they have great difficulty in doing so and no sooner do they make up their minds than the advantages of the opposite side pop up once more, and the whole question is reopened. We say of such people that "they do not know their own minds," and, like many other popular sayings, this one has much truth in it.

The trouble with people who cannot stick to a decision is, in most cases, that they do not know their own motives. Frequently this is because they refuse to know them. Some motives have more social prestige than others, and most of us like to think that all our actions begin with motives that we regard as desirable. So we refuse to recognize any others. But no matter whether our motives are unclear to us because we have not learned to know to what goal they lead or because we refuse to look them squarely in the face, the

result of their lack of clearness is that, instead of giving rise to behavior that runs straight to a goal, they result in constantly shifting behavior, in changing decisions, and lack of purpose. Every one is activated by many motives, and it is inevitable that these motives should often conflict with each other. But if we know what our motives are, if we bring them out into the open where the conflict can be seen, it will sooner or later be brought to a close. It is fighting in the dark that makes the trouble.

Conflicting motives, however, are not the only causes of difficulty. There is also the danger that motives may run over into overt action before they have become organized into large enough units to accomplish much. The person who must gratify each little desire as soon as it arises; who cannot subordinate his desire for candy and movies to his need for a new suit; who is unable, in turn, to refrain from buying the suit on credit, even though he knows that he is not likely to be able to meet the payments, and who thereafter borrows from his friends as long as their good-nature holds out is likely, sooner or later, to find himself in a good deal of trouble. When every little immediate motive takes over the entire control of the organism and then leaves it to run wild until a new motive comes to the fore, not much that is worth while is likely to result.

Conflicts between the various activities of which an organism is capable may then occur either at the intra-organic level as conflicts between motives or at the external level in the form of unorganized and conflicting actions. Conflicts between motives result in delayed action, but, if the motives are clearly understood, the delay may be utilized in organizing them along the lines of a major purpose. If they remain confused and unclear, the conflicts between motives delay action without accomplishing anything useful by the delay. Since this state of delayed action is neither comfortable nor satisfying, the chances are that sooner or later one or

another of the motives will get its way, and some impulsive action will be carried out.

The best way to solve the difficulties that come when motives conflict is to try to organize them into larger units that work together instead of separately. This process or one closely related to it is sometimes known as *sublimation.* The idea underlying the theory of sublimation is that it is possible to transfer the energy or drive aroused by a certain motive to an overt activity different from that to which the motive commonly leads. According to this theory, a person, unable to gratify in the normal way such a fundamental motive as sex, may, by some method that is not quite clear, succeed in attaching some other form of external expression to the organic state that is the normal motive for sex activity. So the disappointed lover turns to art, poetry, or some other form of creative work as an outlet for the sex drive. Recent investigation, however, makes it seem very doubtful that motives work themselves out in just that way. If they did, we should expect the disappointed lover to write better poetry or paint better pictures than the one whose love affairs have run along smoothly, and there is no evidence at all that he does. Sublimation probably means nothing more than the formation of a major purpose on a practical rather than a fantastic basis. It comes as the result of understanding our motives, organizing as many of them as possible to contribute to this purpose and reducing the others to a subordinate level at which they will least interfere with its accomplishment.

There are other less desirable ways of handling conflicting motives. One is by day-dreaming. Motives that cannot be allowed to run over into overt action may find an outlet in this way. If the day-dream is used as a substitute for action, it becomes harmful. If it takes the form of an imaginary achievement of the goal for which one is actually striving, it may, like the sight of the goal itself, spur one

on to greater effort. Probably few great accomplishments have been brought to successful issue without anticipation of the end to help one over the hard places. But the day-dream does not dispose of a motive. Thinking about appetizing food when one is hungry does not lessen the hunger; if anything it increases it. So, when day-dreaming serves as a substitute for actions impossible or undesirable to carry out in actual life, it does not bring conflicts to an end but prolongs them instead.

Another common method is known as *rationalization.* Rationalization means that, when you want to do something that you know is unwise, you try to convince yourself and others that there is some good reason for doing it. Literally it means the building or constructing of reasons. You say that you feel you really should play bridge to-night instead of preparing your mathematics assignment because the other three people will be so disappointed if you fail them. Or you tell yourself that this particular necktie is such a bargain that you had better buy it even though you do not need it and do need the money for a new notebook. When the rationalization is delayed until after the act has been carried out and particularly when it is used as a way of justifying ourselves in the eyes of some one else it is popularly known as "alibiing."

Still another way of disposing of motives that hurt one's self-respect is by refusing to look at them, by denying their existence. This, too, is undesirable, largely because it does not work. If the motive is real, it cannot be got rid of by calling it a myth. Better to acknowledge it and then, having done so, to decide frankly that the satisfaction that might come from gratifying it would not be worth the price. It is a mistake to feel that every motive must work itself out in action. It is you that have to be satisfied, and you, as a total and lasting personality, count for much more than any of your temporary states. Real satisfaction does not come

from yielding to every impulse but from organizing one's impulses toward a unified end.

Motivation as a Factor in College Success

In this long discussion of motivation we may seem to have wandered a long way from the college student. It is time for us to return to him.

When we say that a student is failing in his college work because he is not properly motivated, we may mean any one of a number of things. Perhaps he is so strongly motivated toward something else that his studies have little attraction for him. If we put a piece of fish on one side of the cage and an apple on the other, our hungry cat will struggle to get the fish and will disregard the apple, no matter how red and juicy it may be. As long as the fish is there, he will not even pay much attention to a bowl of bread and milk although he would welcome it if the stronger attraction were removed. In like manner, even students who are not without interest in their class work may neglect it for the sake of other activities that interest them more strongly.

In some cases these students have a real purpose toward which they are aiming, but it is one to which their studies make no particular contribution. It may be that they have been forced by their parents into preparing for one profession when all their interests lie in another direction. More often, however, the trouble is that they lack any single dominating purpose, and so they veer about with every new interest that presents itself. They need the ballast that comes from looking beyond the little gratifications of the moment to the more important goals that lie further ahead. When one is on his way to the big game the moving picture houses along the road have few attractions for him.

Apart from counter-attractions, however, motivation varies in degree or intensity. We all know people who seem

to have little interest in anything. In college they take no part in extra-curricular activities, pay little attention to sports, and do not go out much socially. They make few friends and no enemies. They have no particular hobbies. They attend classes and prepare their assignments in a docile but unenthusiastic manner; they rarely ask questions and take no part in class discussion. They never read anything beyond the formal assignments, except, perhaps, the daily newspaper and a little light fiction. They do not always fail completely, but their accomplishments are far below their abilities.

There are a number of possible causes for this condition. Sometimes it has a physical basis. Unrecognized infections of various kinds may sap one's energy to such an extent that no attainment seems worth the effort it would cost. Sometimes it is the result of repeated frustration. Persons who have too often been prevented from doing what they set out to do are likely, sooner or later, to reach a stage at which success seems impossible. So they build up all sorts of protective mechanisms. They may take a "sour grapes" attitude, telling themselves and others that none of the purposes for which people work are worth while. Their apparent indifference may be only a pose to cover up the lack of self-confidence which keeps them from making a real effort. Or they may have learned to find satisfaction in an imaginary world where they accomplish such wonderful things with so little effort that real life seems pale and insipid by contrast. Perhaps they have become discouraged because of unfavorable comparison with some more able relative or friend. Since even their best falls short of the other person's accomplishment, they come to be ashamed of it and stop competing, perhaps with the half-formed thought that, if they take no part in the race, no one will know what poor runners they are.

Often, too, the trouble with these students is much the

same as with the group previously described. They see no goal ahead of them. They see no reason for working because their work seems to lead nowhere. They have not decided on any profession, and they are content to let their parents provide for their needs. Their intellectual curiosity has never been awakened. From early childhood, information has been showered upon them faster than they have been able to use it. They have never had to fend for themselves even in little matters, and they have never been encouraged to plan for themselves. Now, though they are nearing maturity, they still wait to be told what to do.

Unrecognized motives, motives that the student is unwilling to acknowledge even to himself, sometimes wreak havoc with his accomplishment. The sex motive, particularly in girls, who, more often than boys, have been led to feel that sex desire should be immediately suppressed as something unworthy of their higher selves, is an outstanding example. Many girls, driven by motives which they are unwilling or afraid to face, rush madly from one activity to another, unable to settle down to any one steady purpose, knowing all the time that they are getting nowhere. Their lessons are poorly prepared not because they are incapable of doing good work but because they have no purpose in studying. It is easier for boys to harness the sex motive to the goal of their life work, for good work in college increases their chances of securing a good position, and this, in turn, will make it possible for them to marry later on. But with the girls the connection between succeeding in college and securing a husband are not so direct. With changing social conditions in which the trend is toward joint support of the home by husband and wife, at least during the first few years after marriage, a time seems likely to come when girls, as well as boys, may find that preparation for a career is at the same time the pathway to marriage. But in the past this has not been the case. There is little doubt that much

of the difference between the sexes in their achievements in the arts and science is attributable to the fact that in men the drive toward a career has been given increased strength by its integration with the sex drive, while in women the two motives have acted in opposition to each other.

Childhood Motives and Adult Purposes

Children and adults differ from each other in many ways, few of which are more significant than the differences in the motives by which their activity is aroused and directed. Children work for goals that are near at hand. They sometimes make plans for the future, but their visions of distant goals are nebulous. A glimpse of something nearer at hand soon disperses them. They are deceived by perspective. The molehill in the immediate foreground shuts out the view of the mountains in the distance. But as maturity is approached the normal, well-balanced individual becomes more nearly able to appraise his goals on the basis of their true worth, with less attention to their nearness or remoteness.

How shall we measure maturity? Not by years or by stature, not by the franchise, the marriage certificate, or the college degree. The mark of maturity is the ability to organize one's life for a purpose and to hold steadily to the road whether it be rough or smooth. Some persons reach this stage early; others never arrive at it. The student who finds himself nearing the end of his college life without having formed any plans by which he can direct his future will do well to pause and consider the matter, for a purpose in life is something for which there is no substitute. Neither wealth nor education can take its place.

Chapter XXIII

ADULT BEHAVIOR AND SOCIAL CUSTOMS

Do people who are "opposites" usually attract each other?

Why do some people believe in fortune telling?

How do we acquire our beliefs?

Do adopted children grow to look like their foster parents?

Under what conditions are customs most likely to be preserved? What conditions make for rapid modification of customs and beliefs?

What is the relation of childhood experience to adult attitudes toward customs and beliefs that differ from our own?

Individual Differences and Group Similarities

From cradle to college diploma is a long way and many things happen along the road. In the course of the journey the babies, who at the outset looked and acted so much alike, grow to be men and women who neither look alike nor act alike.

But although no two of them are alike, some are more nearly alike than others. The behavior of no two is the same, but they have now formed groups that have some characteristics in common. These groups are called nations, communities, societies, clubs, and each of these groups has certain rules, certain traditions and customs that survive, although the membership of the group may change. Even the temporary groups that you see about you on the streets

are made up of people who have certain characteristics that tend to distinguish them from others.

Here are a number of people watching the work of excavating for a new building. Few of them know each other. Most of them will never see each other again. What factors can such a group have in common with each other?

Look again. You will note that the group is composed almost entirely of men and boys. Once in a while a woman may pause for a minute or two as she passes, but she does not remain long. So the first common factor we note is that of sex.

Observe more closely. A few of the men may be well-dressed, but the greater number of them are in working clothes, many of which are patched and ragged. These are usually the ones who stay longest. If you inquire, you will find that a large percentage are unemployed. That explains why they have time to loiter around. And from these characteristics alone, maleness, interest in building operations, and unemployedness a good many other resemblances may be inferred. Their economic status is probably rather low; they live for the most part in the poorer sections of the city, and it is probable that a good many of them are receiving aid from social agencies. A little investigation would be almost certain to reveal many other points of resemblance. The similarities would not hold for all of them, but they would be found in so much larger a proportion of the men in this group than among men in general that we have a right to think of them as group factors. Yet the group itself is a temporary thing and its members are even more temporary. Individuals come and individuals go, but in spite of its shifting membership, the general character of the group does not greatly change from hour to hour or from day to day.

One of the city newspapers carries an advertisement of a sale of children's clothing at much reduced prices. Will the

people who attend the sale have any characteristics in common? Indeed they will, so much so that we can be pretty certain in advance what some of these characteristics will be. We can rest assured that most of the shoppers will be women, that they will be mothers, and, if we know the size-range of the clothing, we can make a fair guess as to their average age. From the character of the shop where the sale is held we can infer something about their social and economic status. Whether they are wealthy or poor, we can be sure that most of them are inclined to be thrifty or they would not be patronizing sales. Yet this group is even more temporary than the one previously described.

There is an old saying that people who are opposites attract each other, but neither psychology nor sociology is able to find much warrant for this statement. Even temporary groupings of human beings seem to be formed on the basis of similarities rather than differences. And in the more permanent groupings such as communities, clubs, societies, or professional groups the similarities that led to the original grouping become increased through mutual imitation and the development of class consciousness.

We have seen that even in childhood the feeling of group consciousness has a powerful influence upon behavior. Among adults this influence is even stronger. A large part of our behavior is determined by the fact that the other members of our group do certain things in certain ways. We are all the slaves of custom. It is largely through custom that we have learned to look upon certain acts as right or wrong, in good taste or in poor taste, moral or immoral. We wear certain clothes and not others, use certain words but not others, believe certain things and reject others, form political allegiances, join clubs and lodges, perform a thousand unnecessary and troublesome acts for no other reason than that they are customary. On a sweltering summer day, what man would not be more comfortable to go to his office

garbed only in the cool simplicity of a suit of athletic underwear? But what man would have the courage to try it, and what would be the likelihood of his escaping the police if he did so? The Oriental makes use of signs and talismans to keep off the evil eye; the educated American, chiefly in jest but still with a little undercurrent of feeling that it is better not to take chances, knocks on wood to insure the continuance of good fortune. He omits the fatal "13" in numbering the floors of his hotels and office buildings. Clairvoyants, soothsayers, tea-cup readers, fortune tellers of all kinds still carry on a flourishing trade in most cities. I quote the following from the "personal" column of my morning paper.

> WOMAN OF MYSTERY
>
> Born with a remarkable power, tells you what you want to know, good or bad. No questions asked. If in trouble, unhappy, discouraged with life, you need my help. Satisfaction guaranteed. Tel.——.

To-day's issue contains twelve advertisements of this kind; on Sundays the number is greater. And this is in an "enlightened" American city in the year 1933! Yet, when you stop to think of it, are all your beliefs based upon logical evidence? Of course not. You believe many things, merely because people in your group whose opinions you respect have told you that these things are worthy of belief. They cite evidence, it is true. But so do the astrologers and the "women of mystery." Logic plays a much smaller part in determining beliefs than most of us suppose. Actually, unless something rather drastic occurs to disturb our faith, most of us share the beliefs and opinions and follow the customs that are current within the social groups to which we belong. We change about from group to group, but each group exerts some effects upon our behavior. First of all, in the lifetime of each of us, is the family group,

and it is the beliefs and customs of the family to which we first learn to conform.

Assortative Mating

The family does not begin with the birth of the first child but with the marriage of two adults. These adults are "opposites" in the sense that they are man and woman. But apart from sex and the secondary mental and physical characteristics that are likely to go with sex, do similarities or differences between man and wife predominate? All of us can point to instances where men have married women very different from themselves. But are these cases the rule or the exception?

A good many studies have been made in an attempt to answer this question, and the results have on the whole been remarkably similar. No matter what trait is considered, resemblances between husband and wife are more common than chance alone would lead us to expect. Tall men are likely to marry tall women; short men, short women. Educated people seek other educated people as mates; the uneducated marry the uneducated. Even hair color and eye color are factors in assortative mating; blonds being a little more likely to marry blonds than brunettes and vice versa. A common interest in music, in athletics, in reading, in church activities, or other similar matters often forms the starting point of a courtship that leads to marriage. And so on through an almost interminable list of physical and mental traits. For some of these traits the usual marital resemblance is high, in others it may be only slightly greater than chance. But in practically all cases the tendency is toward similarity between husband and wife rather than dissimilarity.

A rule so general as this prompts us to ask its reason. First of all, we must remember that from earliest childhood common interests are of great importance in the formation

of social groups both large and small. Children find that it is more fun to play with those who like to do the same things that they like. As they grow older this feeling is intensified by experience. It is not surprising, therefore, to find a similarity of interests between people at the time of marriage, and, if the marriage is a happy one, the original similarity is likely to be increased through mutual desire to please each other and through the identification of self-interest with family interest. Similarity of education, of social status, of religious belief, and so on all tend to make for similarity of interests. Moreover, people of the same group are more likely to become acquainted with each other than those from different groups. Propinquity plays its part in the selection of a mate, and, as we have seen, propinquity usually means some degree of similarity.

There is still another factor. During childhood both husband and wife were greatly influenced by the examples set by their parents. Every one who looks back to a happy childhood is likely to feel that his parents were highly admirable persons and that most of their behavior and attitudes were "right." And this feeling of "rightness" with reference to one's parents is not without its effect upon one's own future choice of a life partner. Some psychologists place much more emphasis upon this point than the actual facts appear to warrant, claiming that most men are all unknowingly attracted by women who are like their own mothers, while girls try to duplicate their fathers in their choice of a husband.* It is not at all unreasonable to suppose that the love and admiration which most people feel for their parents predispose them to be attracted by persons who are like the parents. In part, at least, this may account for the tendency for husbands and wives to resemble each other in physical as well as in mental traits.

* This theory is a part of the doctrine of the "Œdipus complex" described on pp. 281-282.

There is good reason for believing that community of interests and points of view has much to do with determining whether or not a given marriage will prove to be a happy one. Sometimes, it is true, married persons seem to work out a fairly satisfactory relationship on the basis made famous by Jack Sprat and his wife, but except for relatively insignificant matters this arrrangement is not likely to be successful. *Incompatibility*—the term which figures so largely in the records of the divorce courts—is in many cases just another word for *dissimilarity*. If one were to compile a book of rules on how to choose a husband or wife, Rule No. 1 might well read, "Select some one whose interests and points of view are not radically different from your own."

The tendency for like to choose like is not confined to husbands and wives. Not long ago the editor of a well-known magazine on child training wrote me as follows:

> "Several people have written us within the past few weeks to inquire whether or not there is any basis for the popular idea that adopted children grow to look like their foster parents. Can you let me know whether or not there is any scientific foundation for this belief?"

In a literal sense, of course, there is none. But the fact that the belief appears to be so widespread suggests that it may be worth looking into. As a matter of fact, the answer involves a number of points of psychological interest. Most children are placed for adoption through social agencies of one kind or another. It has been the experience of these agencies that the chances for the adoption to work out well are much greater if the foster child resembles the foster parents as closely as possible. So most of these agencies make a definite attempt to place blond children with blond parents, brunettes with brunettes. In this way parents and children are more likely to escape the thoughtless comments

of acquaintances about the child's lack of resemblance to his supposed parents, comments that are embarrassing to the parents and may be acutely painful to the child if he knows or suspects his true status. If the agency has any evidence as to the child's potential mental ability, this, as well as appearance, is taken into account in trying to find a home for him. The slogan of most up-to-date child placing agencies is, "Fit the home to the child." Here we have a very definite recognition of the practical fact that compatibility goes with similarity rather than with dissimilarity.

Not only the agencies that supply the children but the foster parents who adopt them are more likely to select children who are like themselves than they are to take those who are different. Often, children are adopted to take the place of an own child who has died. In such cases there is likely to be a strong tendency to select children who resemble the child that has been lost.

Some further resemblance develops after the adoption has taken place. The adopted child, it is true, will not grow to resemble the foster parents in features or coloring any more closely than he did before he was adopted. But he is likely to adopt a good many of their individual habits of speech and manner. He will follow their customs; be influenced by their attitudes; accept, at least for a time, their prejudices and beliefs. Throughout all his early life not only his food and shelter but his friends and acquaintances, his toys, his schooling, and practically everything that surrounds him will be of their choosing. As he grows older he will discard some of his early teaching, he will change some of his attitudes and adopt new ones. But many of them will persist. Foster children, therefore, are likely to resemble their foster parents to a greater extent than would be the case if they were assigned by lot; first, because of assortative selection and secondly because through the intimate associations of family life they are likely to adopt many of their foster

parents' ways and manners. And when their turn comes for parenthood, the chances are that they, just as "own" children do, will hand down many of these ways and manners to their children, not as a biological inheritance such as was described in Chapter III but as a social inheritance.

From the time of his birth, therefore, each child is a member of a social group, the family, which has certain features that differentiate it from all other groups. Its members have certain interests in common, they identify themselves with each other and act in coöperation with each other. To the similar interests that drew husband and wife together at the start has been added a common interest in the group as a unit. Self-interest has to some extent been merged in family interest. People sometimes speak of this identification of the self with the group as the "extension" or "projection" of the ego. The same sort of identification takes place within other groups than the family. We speak of "my country," "my club," "my school," "my church." In some respects we may think of these groups as organisms analogous to the human body. They have certain interests peculiar to themselves; they have a definite form of organization and their members work together to achieve a common end. Like the body, the group is constantly changing, and yet it maintains a definite form. Like the body, too, it perpetuates itself in its offspring.

It is to social inheritance that we owe most of the manners and customs that are found in society to-day. Unlike biological heredity, which comes only through the parents, social heredity comes from the community as well, and as children grow older the importance of the community influence steadily increases, that of the parents decreases.

The Relationship of the Individual to the Community

We have seen how temporary groups are formed on the basis of a common interest. We have seen, too, the part

played by community of interest and background in the selection of husbands and wives. And finally we have seen how, within the family, habits, attitudes, and points of view are strengthened and perpetuated. All these factors play their part in the building up of the larger and more permanent groupings that we call communities, societies, cities, nations. There are external factors that tend to bring people with a common interest together. Once together, each forms part of the other's environment. Through interacting with each other, similarities in behavior and attitudes tend to be strengthened, dissimilarities that occasion conflict to be ironed out, as the weaker members gradually yield to the stronger. Community customs, beliefs, prejudices, ideals are determined and perpetuated in part by assortative grouping at the time when the community is formed and in part by interaction between its members after it is formed and as it continues to grow.

In these larger communities, children are of necessity subordinate members. They live within the community; they are supported and protected by it, and much of the community effort is directed toward their welfare. But as individuals they play a minor part. They have little influence upon community opinion; they accept its dictates unquestioningly; they adopt its customs and accept its beliefs. As long as childhood lasts and as long as the individual remains in his home community, he is not very likely to come into active conflict with its customs and institutions because they are so integral a part of life as he knows it.

Many people maintain this childish attitude with respect to institutions and customs throughout life. To some extent we all do so. Unless something happens to disturb our faith we are all inclined to go on in the same old grooves. Those who are mentally alert are more quick to observe discrepancies; their doubts and questions are more easily aroused and once aroused are less easy to satisfy. Those who are

mentally sluggish or whose points of view have been fixed by an emotional tie-up which makes them unwilling to change can be stirred out of the old pathways only by some rather drastic experience.

A few fortunate persons are so reared that even in childhood they are brought in contact with a wide variety of different customs and beliefs, and so they grow up with an attitude of tolerance for those who differ from themselves. This makes it relatively easy for them to adjust themselves to new conditions. Others cannot adjust. They must either reform conditions to suit their ways or find new conditions that agree with their ways.

In every situation with which the adult is faced we see these modes of reaction at work. Take industry as an example. Here we have the phlegmatic, docile worker who takes it for granted that whatever the boss says is all right. Here is another who is chronically dissatisfied, who shifts about from one job to another, always seeking the elusive spot where all things are to his liking. He neither yields to conditions nor makes a determined effort to change them. He just quits. Here is another who is continually making trouble. He objects to many things and can see no point of view except his own. This thing is wrong not because it works harm to the group but because it conflicts with his own established idea of what is right. Finally we have the more flexible personality who can look at matters in a more tolerant fashion, but who nevertheless sees where changes would be desirable. He is likely to be the one who accomplishes things, and he does so without sacrificing his own personal integrity and interests or upsetting the whole works. Such men are real leaders.

In family relationships we see the same mechanisms at work. Here is the wife who patiently yields to her husband's every crotchet, who submits to his bullying and sacrifices her own welfare and that of her children because she has

never learned to assert herself as an adult. Or we have the husband who apathetically accepts the slovenliness and incompetence of his wife, with a helpless feeling that nothing can be done about it. Others, husbands and wives alike, make for the divorce court at the first difficulty; still others take it out in quarreling and nagging with no real attempt to get together and straighten things out on a rational adult basis. Others, while adopting a tolerant attitude toward the shortcomings of their mates do not hopelessly yield to circumstances. Instead they try to join forces in making such changes as seem dictated by the requirements of the family group rather than by blind conformance to old habits and customs.

The problem of the individual in relation to the group is to find ways of effecting such modifications in group custom as seem desirable to him without estranging himself from the other members. Different people settle this problem in various ways. Chiefly, perhaps, they solve it by identifying themselves with groups that are much like those within which they have grown up. In this way they avoid conflicts for themselves, but they also help to perpetuate existing custom. This is not wholly undesirable for, while we should hesitate to accept the doctrine that "whatever is, is right," it is also unlikely that "whatever is, is wrong." Nevertheless, for his own highest development, every adult should try as far as possible to free himself from the bonds of his immediate social heritage by finding out how other groups live, what they think and believe. There is nothing like breadth of experience to enable one to select more wisely from out the many customs and institutions that exist those which are best fitted to survive. By associating freely with many different classes of people we not only gain in wisdom but in tolerance. Before starting out to reform society it is well to make sure in what directions reform is most needed. Many things seem wrong or undesirable to us just because they

do not conform to our own social heritage. The question an intelligent man or woman should ask, when he finds himself confronted with some new custom, institution, or belief is not: "Is this the kind of thing I have always believed to be right?" but rather: "Is this likely to work out to the advantage of society as a whole?"

How Customs Become Modified

As long as a given group remains by itself, its customs and its institutions are likely to undergo little change. In the isolated mountain communities studied by Sherman * the language, the habits, the superstitions, the modes of living of the people had changed but little over a period of more than a hundred years. It is when new people join the group and when there is free intermingling with other groups that modifications of belief and changes in custom take place rapidly. Often, inconvenient and useless customs are retained from generation to generation for no other reason than that nobody has challenged them. Why do Americans find it necessary to transfer the fork back and forth from the left hand to the right while Europeans save themselves the trouble by training themselves to lift food to the mouth with the left hand? If Great Britain were not an island, is it likely that she would continue her custom of having traffic keep to the left-hand side of the street instead of to the right, as is the practice in other nations? With free intercourse from group to group, outworn customs are more quickly abandoned because the newcomers are quicker to observe places where changes can profitably be made than are the old residents who have been inured to existing conditions through long habit.

* Mandel Sherman and T. R. Henry, *Hollow Folk* (New York: Thomas Crowell, 1933).

Adult Activities

The activities of most adults can be grouped under a few heads. There are the activities centering around the home and family, such as the care of the household, the bearing and rearing of children, and the social life of the home. There is the work by which one earns a living and the social relationships connected with it. There are a certain number of outside organizations that claim a portion of one's time, such as the church, clubs, and civic organizations. Add to the list a few recreations not included under these heads; perhaps a little time for study, though this is less common than it should be; some further time for idling; and from ten to eleven hours daily for eating, sleeping, bathing, and dressing and you will have a fair picture of the way the average person spends his time from the early twenties until his death. Expressed in these terms it sounds like a monotonous and none too attractive existence, and far too many find it so. Yet this is the period when new worlds are discovered, when science discloses fresh secrets to her disciples, when masterpieces are created and genius comes into its own. Maturity should be the most vital and exciting period of life for it is its culmination. It is the time when childhood promise is fulfilled in achievement, when the works are achieved by which men are remembered. Yet to many it is a time of disappointed hopes, a time of idle drifting, or just a succession of monotonous years during which they plod along, not particularly happy, not especially sad, unwilling to bestir themselves to learn new things, too much concerned with the trivialities of the moment to seek for better things ahead, adopting more and more strongly as they grow older the attitude that their time for learning is over and whatever deficiencies they possess can no longer be corrected. Whether or not this attitude is justified we shall see in the next chapter.

Chapter XXIV

THE MATURATION AND DECLINE OF ABILITIES

Why is it harder to measure "general intelligence" in adults than in children?

Between what ages do most abilities appear to reach their peak?

Is the curve of growth and decline the same for all forms of ability?

In general, what kinds of ability appear to decline most rapidly? Most slowly?

Do all people grow old at the same rate?

Is the saying that "you cannot teach an old dog new tricks" partially or wholly true for human beings? What are some of the chief reasons why older people seldom acquire new skills? What kinds of things are hardest for older people to learn?

Have most of the "masterpieces" of famous men been produced at any one typical age? About what has been found to be the average age?

Changes in Ability after Maturity

Everyday observation tells us that the pattern of abilities, both mental and physical, continues to undergo change even after maturity has been reached. The man of forty differs from the youth of twenty in ways that are not wholly dependent upon his greater experience. With the changes in physical appearance that commonly occur between these

ages we are all familiar; so much so that although now and then we meet some one whose appearance greatly belies his age, as a rule we estimate the ages of strangers with a fair degree of accuracy. We all know, too, the gradual loss of the overflowing physical energy that sets young men to wrestling and tussling with each other with the thermometer at 100° in the shade. Although at forty the man who has always done heavy manual labor may carry on his work about as efficiently as before, he does not put so much snap into it. His muscles may still be strong, but they are less resilient. The man of forty moves more slowly, particularly if, as is often the case, he has put on weight.*

But although general observation tells us certain things, when we try to make exact comparisons between the abilities of younger and older adults we find that the task is not as easy as might be thought. Unless we wait until the young have grown old, we shall not be studying the same individuals at different ages, and it is not easy to make sure that factors other than age are not influencing the results. For example, in some of the earlier studies on the abilities of very old persons, the subjects were taken almost wholly from charitable institutions, poor houses, and homes for the aged. The very fact that these persons had failed to make provision for their old age when they were younger suggests that they were probably not highly competent at any age. As people grow older they are likely to become less interested in merely trying their skill; they want to see reasons for their work. Tasks that merely test what they can do are therefore less certain to draw forth their best efforts. Differences in recent experience also play a part.

* The relationship between speed of movement and weight is reciprocal. The person who moves quickly burns up more fuel in that way and so is less likely to store it as fat. Moreover, since fat is inert tissue which has to be moved by muscular effort in which it does not, itself, share, the person who carries around excess fat is likely to move more slowly because he is hampered by the load.

Many of the older subjects will have lost interest in activities that have no relationship to their life work and so make a poor showing on certain tasks, not so much through genuine loss of ability to acquire these skills as through being out of practice in performing them. With increasing age, interests and activities become more highly specialized. Perhaps the fairest way to test the ability of an adult would be to see how well he can do his chosen kind of work.

Until recently we had no very reliable information about the changes in ability that occur after maturity has been reached. During the past few years, however, several outstanding attempts have been made to study this problem. Miles,* enlisted the interest of clubs and social organizations of various kinds by offering to pay the organization for the time spent by its members and their relatives in taking a series of tests. A special bonus was offered for bringing in old people. By this means he was able to be reasonably sure that his subjects were of about the same social class and presumably of about the same native intelligence, regardless of their ages. The fact that they, or rather the organization, was receiving pay for the work undoubtedly lent it additional importance in the eyes of the subjects, and so made it less likely that they would fail to put forth their best efforts.

The tests used were of many kinds. In addition to formal intelligence tests there were a number of tests of motor ability, of perceptive ability, of learning and memory, of speed of reaction. Self-estimates and questionnaires, calling

* W. R. Miles, "Correlation of Reaction and Coördination Speed with Age in Adults," *Amer. J. Psychol.*, 1931, 43: 377-391; "Measures of Certain Human Abilities Throughout the Life Span," *Proc. Nat. Acad. of Science*, 1931, 17: 627-633; "Age and Human Ability, *Psychol. Rev.*, 1933, 40: 99-123.

Catherine C. Miles and W. R. Miles, "The Correlation of Intelligence Scores and Chronological Age from Early to Late Maturity," *Amer. J. Psychol.*, 1932, 44: 44-78.

for opinions and points of view on many subjects and for expressions of interest in various activities, were also employed. Not all the results have been published as yet, but the following table shows the general trend. In this table the scores for the different age groups have been expressed as percentages of the average score made at the age when the particular ability was at its peak. The peak is always counted as 100 per cent. Thus, in speed of reaching and grasping the highest average score was made by the subjects who were between eighteen and twenty-nine years and this score is therefore counted as 100. Subjects between the ages of ten and seventeen years attained, on the average, 92 per cent of this high mark; those between the ages of thirty and forty-nine, 98 per cent; those from fifty to sixty-nine, 88 per cent; and the old people between the ages of seventy and eighty-nine averaged 70 per cent of the maximum.

Table 7

RELATIONSHIP OF CERTAIN ABILITIES TO AGE

(Adapted from Miles)

	Age groups				
	10–17	18–29	30–49	50–69	70–89
1. Reaching and grasping	92%	100%	98%	88%	70%
2. Speed of rotary movement (turning a crank)	90%	100%	97%	89%	72%
3. Speed of finger reaction	87%	100%	98%	99%	71%
4. Learning a maze	95%	100%	92%	83%	55%
5. Comparison and judgment	72%	100%	100%	87%	69%
6. Visual acuity (with glasses if worn)	100%	95%	93%	76%	46%

In the Otis intelligence test it was found that the peak came at about eighteen years of age. Since we do not know where the zero point of this test lies it is not easy to express the results as percentages of the maximum as has been done in the foregoing table. Miles uses a number of devices to

show the relationship of scores to age, but, since most of them involve the use of somewhat complicated mathematical procedures, we shall present only the simplest and most easily understood figures here.

The following table shows the average IQ's computed on the basis of the Otis norms * for each successive decade from the twenties to the nineties. The subjects have been divided into three groups according to education.

Table 8

RELATIONSHIP OF INTELLIGENCE QUOTIENTS TO AGE AND SCHOOLING

(After Miles)

Age	*Eighth grade or less*	*One to four years high school*	*One or more years in college*
20–29	101	107	118
30–39	94	106	116
40–49	93	105	117
50–59	89	100	111
60–69	85	95	106
70–79	82	95	100
80-89	75	85	91
90–99	—	79	—

From Tables 7 and 8 it appears that older people suffer a greater handicap in the more purely physiological functions, such as visual acuity, than they do in the kind of activities we term intellectual. There is some evidence, too,

* Although the use of the intelligence quotient with adults is open to some question, we have presented the results in this form because it is one with which students are familiar and because the figures are thus made more nearly comparable with those in Table 7. Students should note, however, that whereas Otis, following the example of Terman, assumed that the ability measured by this test reaches its maximum at sixteen years, these results as well as those secured by a number of other workers show that some further growth occurs after the age of sixteen. This accounts for the fact that the average IQ of all three groups during the decade of the twenties is somewhat above 100.

that the loss in those functions that are most often practised comes about a little more slowly than it does in those that are rarely used. The ability to learn to trace a maze, for example, shows a much more rapid decrease than reaching and grasping. Although we think of the former as a more intellectual function, it is one that is little practised outside the psychological laboratory. On the Otis tests, which make use chiefly of verbal tasks, the ability of the subjects who never attended high school and who probably were for the most part engaged in manual labor shows a somewhat earlier decrement than that of other groups who were, we may assume, getting more practice in work of this kind.

Miles also points out that in general the decrement in performance with age appears most strongly in tasks in which speed is a factor. Older people do best in tasks "where diligence is more important than speed." Older people also have much difficulty in learning new material that conflicts with well-established habits, such as a series of wrong products like $4 \times 5 = 28$. It may be noted here that some workers in the animal field have found that old rats have more difficulty than young ones in learning new mazes so planned that the habits formed earlier in learning other mazes conflict with those required by the new maze.

Most significant of all, perhaps, is the fact that even in those tasks where, on the average, the decrement with age is large, some of the older people continue to do better than the average of the younger ones. In this connection Miles makes the following comment:

"Although younger adults tend regularly to score higher in most of the measurements made and older adults to score lower, it is by no means true that all of the high scores belong to the young, the low ones to the old. . . . The measurements of dispersion are consistently large from decade to decade. In reaction time, 25 per cent of the people over 70

years of age were as quick as the average for the total group. In intelligence also, even when speed is a factor, approximately a quarter of the oldest subjects equaled or exceeded the general adult average."

Miles' subjects were for the most part drawn from an urban population. For this reason it is interesting to compare his results with those obtained by Jones and Conrad * from a group of people living in small New England villages. In this study the Alpha intelligence test, which was given to the American soldiers during the World War, was employed.

Figure 73 shows the average decline in ability with age for the entire group. These results agree very closely with those obtained by Miles. In both studies the peak of ability is reached at about the age of eighteen. The curve remains fairly stationary throughout the early twenties and then shows a gradual drop.

Although different tests were used in the two studies, it is possible to transmute the scores earned on one into the most probable values for the other. Since the two tests are not very different from each other in content, it is not likely that this transmutation involves much error. When this is done it appears that at every age the village group (which includes some people living on nearby farms) makes an average score about half-way between that earned by Miles' subjects who had only grade school education and that earned by those who had gone to high school. This is about what we should expect.

The Alpha test is divided into eight sub-tests, each comprising a different kind of task. Jones was interested in seeing whether the age decrement is equally great along all the lines tested. He found that it is not. Test 4, which is an

* H. E. Jones and H. S. Conrad, "The Growth and Decline of Intelligence; a Study of a Homogeneous Group between the Ages of Ten and Sixty Years," *Genet. Psychol. Monog.*, 1933, 13: 223-298.

"opposites" test (see p. 329), and Test 8, which is a test of general information, show no indication of a decline with age up to age sixty. The curve remains stationary. Arithmetical reasoning and the ability to rearrange the words in

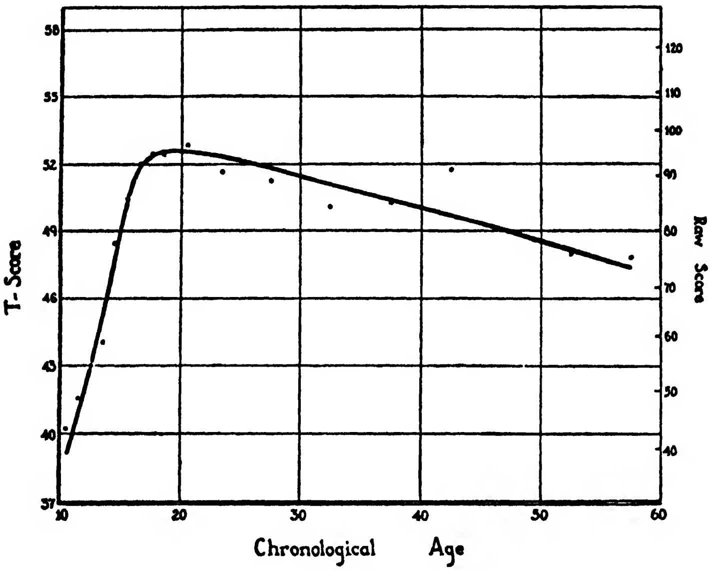

FIGURE 73

GROWTH AND DECLINE OF INTELLIGENCE AS MEASURED BY THE ARMY ALPHA TEST

(From H. E. Jones and H. S. Conrad, "The Growth and Decline of Intelligence: a Study of a Homogeneous Group between the Ages of Ten and Sixty." *Genet. Psychol. Monog.*, 1933, 13: 223-298. Courtesy Clark University Press.)

"dissected" sentences show only a small loss. The ability to follow oral directions shows a fairly sharp loss from the early twenties up to about thirty-five after which no further change takes place before the age of sixty. The greatest age decrement is seen in the tests of mathematical completion and giving analogies, and in a so-called test of "common

sense" in which the subject is required to select the best one out of a list of answers to each of a number of everyday questions.

As far as test performance is concerned, therefore, there seems to be no doubt that, if we consider the average of many different kinds of intellectual performance, a small but steady decline in ability takes place after the early twenties. But this decline is not equally well marked for all tasks nor is the maximum always reached at the same age. Some abilities reach their acme in the teens, others not until much later. Some forms of ability show no evidence of decline up to late middle-age. Individuals of course differ greatly. Some remain intellectually "young" until after they are far advanced in years; others become old in their twenties. Individual differences in the rate of mental decline seem to be quite as marked as individual differences in rate of mental growth, but neither Jones nor Miles was able to discover any definite relationship between rate of growth and rate of decline. Those who show rapid mental development in childhood do not appear to be either more or less likely to show rapid decline in maturity and old age than those whose early growth was slower. If anything there is a slight suggestion of a negative relationship, rapid growth going with slow decline and vice versa, but a good deal more evidence is needed before we can be sure that this is the case.

So much for tests of ability. But what about learning? There is a well-known saying that it is hard to teach an old dog new tricks. If this is true, what is the matter with the dog? Is it, as we might judge from the test results given so far, because he cannot learn the tricks, because he thinks he cannot, or because he is too indifferent to try? And first of all, just how hard is it for him to learn? Let us see what the evidence is for the human animal.

Adult Learning

Thorndike * has made one of the most careful studies of human learning during early and middle maturity that has so far appeared. In this study he canvassed a great many different fields of learning and worked with subjects of many different levels of education and intelligence. It is neither possible nor necessary for us to give all his results in detail but the following are representative.

When university students ranging in age from twenty to fifty-seven years were given ninety practice periods of ten minutes each in learning to write with the non-preferred hand, those between the ages of twenty and twenty-five gained in speed more than those who were thirty-five or older; the averages, in terms of letters per minute being thirty-five and eighteen respectively. The greatest gain in the older group was twenty-five letters per minute; the smallest gain in the younger group was sixteen letters per minute. The ability to *increase one's motor speed* in learning a new task seems to drop off very rapidly with age. But the ability to *improve in quality* shows little relationship to age within the age limits covered. As measured on the Thorndike Scale, the older group gained, on the average, 1.16 units and the younger group 1.11 units. Another group of subjects with the same range of ages as those used in the handwriting experiment studied Esperanto, an artificial language made up according to definite rules and principles. At the beginning of the experiment all subjects were given four tests; a vocabulary test, a test of responding to directions that were given orally, another of responding to printed directions, and a test of paragraph reading. When the subjects had spent a total of twenty hours learning Esperanto, the tests were repeated. The younger students improved

* E. L. Thorndike et al., *Adult Learning* (New York: The Macmillan Company, 1928). Pp. xii + 335.

much more than the older ones in the test of oral directions, a fact that suggests a falling off in auditory perception,* but there was practically no difference between the groups in the other three tests. A comparison of the progress of these adults with that of children from eight to eighteen years of age shows that the adults were decidedly superior, a fact that is in direct opposition to the commonly accepted belief that childhood is the time when languages are learned most easily. It is probably true that correct pronunciation will be most easily acquired during the early years, but the idea that learning to read a new language is beyond the ability of intelligent adults, even after they are well along in years, seems definitely contradicted by these results.

The foregoing experiments were conducted on persons of superior ability. But a group of Sing Sing prisoners whose ability, as measured by standard tests, was distinctly below average showed the same relationship of learning to age as was found for other groups. There was a falling off after the early twenties in learning certain kinds of tasks, but the decrease was not very marked. In learning school subjects—reading, arithmetic, and the like—this drop was estimated to be about one half of one per cent per year during the twenty years from age twenty-one to age forty-one. In a substitution test designed to measure retentiveness over an interval of one week the older men did better than the younger ones, provided the code used was the same on both occasions; but, if it was changed in such a way that new habits had to be substituted for those previously learned, the older men were at a disadvantage as compared with the younger ones. They remembered the old habits better, but found it harder to form new ones that interfered with the old. Miles, you will remember, obtained the same results.

In order to obviate, as far as possible, the spurious effects

* Note the resemblance to the age changes in visual acuity found by Miles (p. 542).

of differences in experience which might enable one group to make better use of past habits of learning than the other, Thorndike conducted a number of experiments on the learning of new and meaningless tasks in which it seemed probable that differences in experience would play a very small part in determining the results. For example, he had blindfolded subjects attempt to draw lines of a specified length, with only the words "Right" or "Wrong" to aid them. In

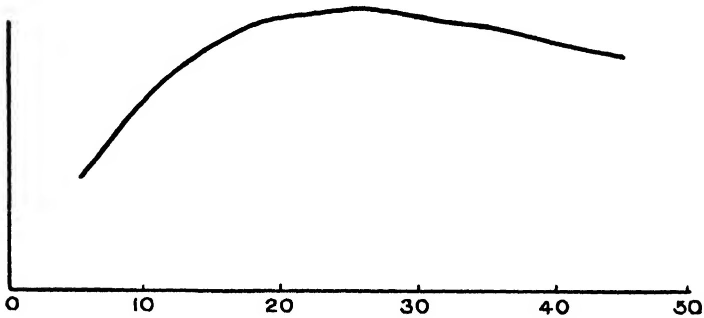

FIGURE 74

THE GENERAL FORM OF THE CURVE OF LEARNING ABILITY WITH AGE

(From *Adult Learning* by E. L. Thorndike. Courtesy of The Macmillan Company.)

these experiments the age difference in learning ability was decidedly greater than in those involving the learning of such things as adults commonly have to learn. For all the experiments together, the general tendency was for a total drop in learning efficiency of about 15 per cent between the ages of twenty-two and forty-two years. But when one remembers the great differences in ability to learn that are shown by individuals at any one age, this decrease appears of far less consequence than it might at first seem. There are plenty of individuals well on in years who still learn more easily than the average youth. By putting in a little more time and making a determined effort they may even

surpass their own earlier performances when they may have been less strongly motivated to do well.

If the actual change in learning ability from the third to the fifth decade is so small, why do so many persons who have not yet reached senescence nevertheless get the idea that they are too old to learn? In many cases, age seems to be an excuse rather than a reason. The person who really does not want to make the effort to learn some new thing that would be desirable for him to know, rationalizes by saying that he cannot learn it now; he is too old. Preoccupation with other matters, with getting started in his trade or profession, getting married, founding a home, and rearing his children take up so much of the adult's time and interest that opportunity for study or for practising new skills is not easy for him to find. Accordingly, not so many older as younger adults actually do learn new accomplishments and as a result the popular idea has arisen that learning for older adults is much more difficult than it really is.

This difference in custom has another effect. Adults, especially if they are no longer young, often feel self-conscious and hesitant about undertaking to learn things that not many other people of their age are learning. So they either refrain from making the effort at all, or, if they begin, they learn more slowly than would be the case if they were not hampered by self-consciousness and lack of confidence in their ability to succeed. All in all, there seems to be good warrant for Thorndike's conclusion, which is that the reason many adults fail to continue learning as much or as long as they might is partly because they underestimate their powers of learning and partly because they do not care enough about learning to make the necessary effort to do so.

Productivity and Age

But laboratory tests do not tell the whole story. At what age does the average person do his best work?

Thorndike * reports the results of a study based upon the age at which the *opera magna* of 331 leading scientists and men of affairs were published. Only those persons were included in this study for whom an *opus magnum* could be selected with a fair degree of certainty. The ages range all the way from twenty-four (one case) to eighty-two (three cases) with the average at forty-seven years. The scientists on the average produced their masterpieces a little earlier than the men of affairs. A similar study by Dorland † agrees fairly closely with this one. According to Dorland, the average age at which 400 noted men produced their masterpieces was fifty.

The age of greatest earning capacity will obviously vary considerably with the type of work in which the person engages. For workers in occupations where muscular strength is the chief requirement and for which little or no time is spent in training, the peak comes early; for those in the learned professions it is much later. Thorndike made a study of the salaries received by Methodist clergymen at different ages. For his group of 143 cases there was a steady increase up to about age forty, followed by a plateau which lasted until about fifty-six and a fall thereafter. High-salaried men and low-salaried men showed about the same tendency to vary with age, except that the age changes were most pronounced for those earning the highest salaries.

Bühler ‡ has suggested an interesting theory with regard to the changes in the character of work done at various ages and by persons of different levels of ability. In place of Shakspere's famous "seven ages of man" she proposes a division of the life span into five stages: childhood, which is a time of exploring and manipulating the immediate environment without much thought for the future; youth,

* *Op. cit.*

† W. A. N. Dorland, *The Age of Mental Virility* (New York, 1908).

‡ Charlotte Bühler, Paper read before the Tenth International Congress of Psychology (Copenhagen, 1932).

which is a period of experimentation with an eye to the future; early maturity, which is a period of originality and creativeness; middle age, a period of stereotyped activity with not much falling off in production but with relatively few new ideas; and senescence, which is a period of declining productivity. It is her theory that one of the distinguishing marks of the truly great is to be seen in the prolongation of the period of originality and creativeness at the expense of those immediately preceding and following it.

The outstanding result of all these studies is to show that although we may compute averages, the variation from these averages in individual cases is so great that, if we except the years of early childhood and the late nineties, there is no age within the life span of man at which great accomplishment has not been recorded. Some of our great musicians published work of considerable merit as early as the age of five or six years. Sophocles wrote the *Œdipus* at ninety. Folwell, former president of the University of Minnesota, wrote his monumental *History of Minnesota* during the last years of his life, finishing it just before his death at the age of ninety-six. In his *Senescence,* Hall * cites many other instances of outstanding accomplishment performed long after the traditional age of "three score and ten years" had been passed.

The years from twenty to fifty are the ones when most people do their best work. But fifty is by no means a universal dividing line between excellence and mediocrity. Look at Edison! Indeed the more one studies the lives and characters of those who have continued to do creative work up to a late age or of their humbler fellows, who, although they never achieve fame, nevertheless continue to fill a useful position in the world for many years after the majority have dropped out of the race, the more strongly one comes

* G. Stanley Hall, *Senescence, the Last Half of Life* (New York: D. Appleton Company, 1922), xxviii + 518.

to feel that the vast majority of individuals grow old long before there is need for them to do so. It would be foolish to claim that age is just a notion. It is a fact to which all must adjust as it comes to them. But it is equally foolish to anticipate its ravages before it has actually arrived or to use age as an excuse for failure to accomplish what a little greater effort would have enabled one to perform. Older people may not learn quite as easily as they did in youth, but most of them can still learn.

Chapter XXV

MENTAL DISEASE

Suppose that in a certain hospital about 100 babies are born, on the average, each year. About how many of the hundred will at some time in their lives become patients in a hospital for mental diseases?

Are all mental disorders the result of brain injury or of physical diseases that affect the brain?

Do normal people always perceive things as they are? What is the difference between a normal illusion and a hallucination? Are there any conditions that will produce hallucinations in people who are not insane?

What is meant by a systematized delusion? What is the relationship between mental conflicts and delusions?

What are some of the specific devices by which the mentally ill try to solve their conflicts?

(Keep the following question in mind as you read, and try to answer it afterward.)

Do you think the different mental disorders described here are separate diseases or merely different methods or devices by which the frustrated person tries to find a way out of his difficulties? See if you can think of a series of conditions under which the same original conflict might lead to any one of the disorders mentioned.

How Many People Are Affected?

Few people realize what tremendous social problems are created by mental diseases. Most people think of insanity as something that can safely be ignored. They assume that it

affects but a few persons and that it is almost always due to bad habits or to accidents that affect the brain. The idea that some one near and dear to them may fall victim to it does not occur to them.

Nothing could be much farther from the truth than the assumption that mental disease is rare or that any social group is exempt from it. Pollock,* to whom we are indebted for some of our most careful statistical studies of mental disorders, has made a comparison of the number of first admissions to hospitals for mental disease in the State of New York with the total population of the State. He estimates that "approximately 4.5 per cent of the persons born in the State of New York may, under existing conditions, be expected to succumb to mental disease of one form or another and become patients in hospitals for mental disease. In other words, on the average approximately one person out of 22 becomes a patient in a hospital for mental disease during the lifetime of a generation."

PROBABLE NUMBER AMONG CERTAIN SOCIAL GROUPS WHO WILL DEVELOP SERIOUS MENTAL DISEASE AND BECOME PATIENTS IN A HOSPITAL FOR MENTAL DISEASE

Among 117,000 male children born in New York State in 1927	5,000
Among 111,000 female children born in New York State in 1927	4,400
Among 1,030,000 boys in public schools in New York State in 1927	51,500
Among 999,000 girls in public schools in New York State in 1927	44,000
Among 194,000 male immigrants to the United States in year ended June 30, 1927	10,000
Among 141,000 female immigrants to the United States in year ended June 30, 1927	7,300
Among 3,500,000 World War Veterans whose average age in 1927 was 35 years	154,000

* H. M. Pollock and B. Malzberg, "Expectation of Mental Disease" *Ment. Hygiene*, 1929, 13: 132-163.

These figures are indeed startling, the more so when we remember that although some persons who enter mental hospitals make sufficient improvement to be discharged after a time, a large percentage remain there for the duration of their lives. The financial burden upon the normal population of maintaining the large number of hospitals required to care for such vast numbers of the mentally ill is very great,

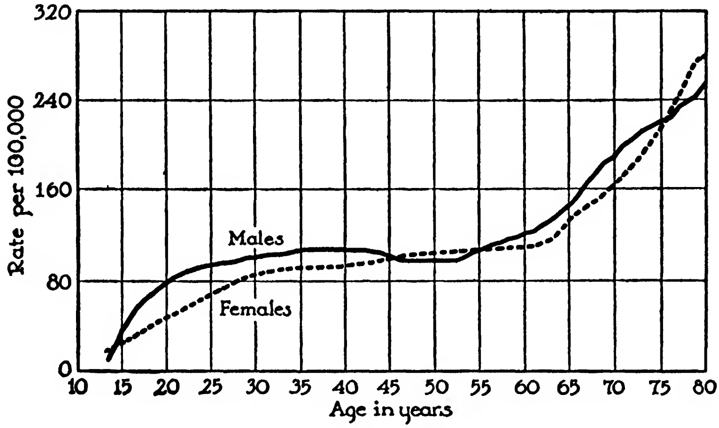

FIGURE 75

RELATIONSHIP OF THE FREQUENCY OF ONSET OF MENTAL DISEASE TO AGE

(From H. M. Pollock and B. Malzberg, "Expectation of Mental Disease," *Mental Hygiene*, 1929, 18: 132-163.)

and the loss to society through the incapacity of so many of its members is even greater.

Although, as we have seen in previous chapters, the early stages of mental ill-health can be observed in childhood and some definite breakdowns occur in adolescence, mental disease serious enough to necessitate the removal of the patient to a hospital for mental disorders is not very common before maturity. Figure 75 shows the relationship of mental disease to age. During childhood the proportion is very

small. The few cases that occur are for the most part the result of diseases or of accidents to the brain.*

Classification of Mental Disorders

Mental diseases as they are known to-day fall into two broad classes. The first are the *organic disorders* in which the behavior disturbance is directly consequent upon a known organic condition affecting the brain. Brain tumors, serious injuries that destroy parts of the brain substance, and general paresis resulting from syphilitic infection are examples. Since the origin and treatment of these conditions is primarily a medical problem, we shall not consider them here. But there are other forms of mental disorders, quite as outstanding in their symptoms and quite as disabling to the individual for which no organic base has been discovered. They affect the way the individual thinks and acts but although we assume, just as in other forms of learned reactions, that some kind of change in the organism has taken place, we do not know in what this change consists. It does not involve any gross destruction of brain tissue, such as is found in paresis or other mental diseases of the so-called organic type. Because the diagnosis in these cases has to be based entirely on the way the affected person behaves, these are known as *functional mental disorders.*

Normal and Abnormal Reactions

Functional disorders appear to be the result of particular experiences through which the person concerned has learned to attach wrong meanings to so many of the situations he

* The student must be careful not to confuse mental disease with mental deficiency. The latter is present from birth and so is found at all ages. Mental disease, as the term is commonly used, includes only those disturbances of thought and action that appear at a later age and are serious enough to prevent the individual from carrying on his affairs in a normal fashion. Mental disease refers to a loss or disturbance of abilities formerly possessed: mental deficiency exists from the start.

encounters that his behavior becomes grossly inappropriate to the conditions that call it forth. In this respect the behavior of these persons differs from that of normal people in degree rather than in kind. All of us have at times been misled into thinking that we saw or heard something that was not there. Usually there was something there but not the thing we supposed. Mistakes of this kind are known as *illusions*. Some illusions of visual perception are experienced under the appropriate conditions by almost everybody. They are normal illusions, resulting from the way the eyes work. A number of these illusions were described in Chapter XII. Here is another one known as the "floating finger illusion" * that you can easily try for yourself. It is due to the fact that you have two eyes which see things from slightly different angles.

Choose a position where you can fixate the eyes on an object at some distance. Bring the tips of the two index fingers together at a distance of about eight or nine inches from the eyes and just below the line of regard. Although your finger tips are actually in contact with each other they will appear to be separated by about two inches and to be connected by a third finger which completely fills the intervening space. Now if, while you continue to look at the distant object you separate the fingers slowly, the third finger will at first appear to be floating in space between them. As the fingers draw further apart the third finger grows shorter and eventually disappears.

Figure 77 shows the Müller-Lyer illusion, one of the oldest and best known of these common illusions of perception. Which of the two horizontal lines in this figure appears to be the longer? Actually they are the same length but because the eye movements tend to run out a little way along the open arrow heads and to stop abruptly at the closed

* This illusion was first described by W. L. Sharp in *Psychol. Rev.* 1928, 35: 171-173.

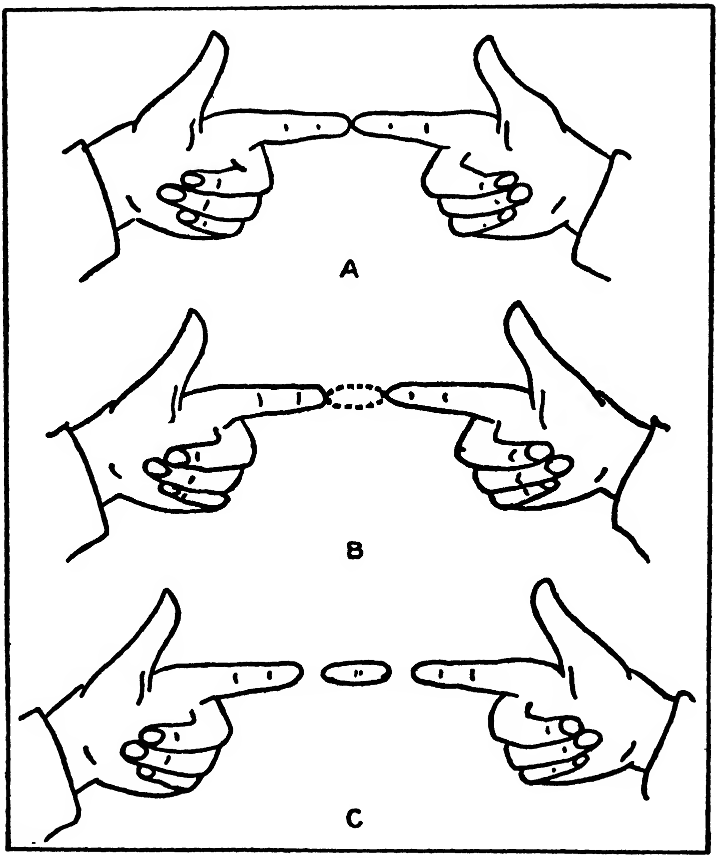

FIGURE 76

THE FLOATING FINGER ILLUSION

(From W. L. Sharp, "The Floating Finger Illusion," *Psychol. Rev.* 1928, 35, 171-173. Courtesy of the Psychological Review Co.)

ones, the line bounded by the open arrow heads appears to be the longer.

Illusions of this kind have attracted a good deal of interest among psychologists because of the light they throw on

fundamental questions of perception. But in addition to these generally experienced illusions of perception, every one occasionally has illusions that are peculiar to himself and are chiefly determined by his organic state at the moment,

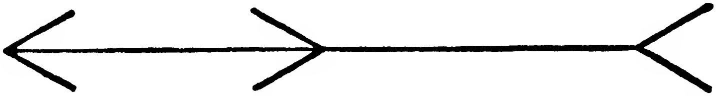

FIGURE 77

THE MÜLLER-LYER ILLUSION

by what he happens to be thinking about, what he is "set" to see or hear.

I am expecting a telephone call. The telephone is in another room from which I can hear the bell but not very clearly. Half a dozen times I stop what I am doing and listen, thinking that I hear it. My state of expectation makes

FIGURE 78

JASTROW'S ILLUSION

(From *The Psychology of Abnormal People* by J. J. B. Morgan. Courtesy Longmans, Green & Co.)

almost any noise sound like the telephone bell. A timid woman alone in the house hears burglars in every room. A superstitious Negro ran to his cabin shrieking frantically that he had been pursued by a tall white ghost that stretched out its long arms trying to seize him. The ghost was a pillow-case on the clothes line, blowing in the wind.

Much of what even normal people perceive is the result

of what they are set to perceive. Show Figure 78 to a friend after having previously told him that you are going to show him a picture of a duck. Tell another friend that you will show him a picture of a rabbit and then show him the same picture. The chances are that the one who expected to see a duck will see a duck; the one who was prepared to see a rabbit will see a rabbit. Getting set to respond in a particular way is in reality the beginning of the act of responding in that way. Unless there is a fairly sharp interference, such as would come, in this case, from being shown a picture that could not reasonably be made to conform to expectation, the activity will run on along its appointed course.

The more intense the preparatory reaction, the more likely it is to over-ride the obstacles caused by discrepancies between expectation and fact and to make the external evidence conform to the pattern set by the internal drive. Emotional states such as anger, fear, jealousy, suspicion are preparatory reactions that may carry all before them. The jealous wife sees infidelity in the most ordinary acts of courtesy shown by her husband to other women. The timid pedestrian sees a bandit behind every bush. The unduly self-conscious person thinks that everybody is looking at him and talking about him.

Illusions due to strong preparatory reactions are experienced by everybody, and when these reactions are not too grossly inappropriate to the situation that touches off the response, no one pays much attention to them. The city woman walking along a leaf-strewn path in the woods starts back at the sight of a half-hidden stick exclaiming, "Gracious! I thought it was a snake!" Here as in many other cases the phenomenon which Hollingworth calls *redintegration* plays an important part. From a single feature one reconstructs a total situation. Something about the stick resembles a snake and the woman, who in any case is prepared

to see snakes, responds as suddenly and as strongly to this single feature as if the snake were there.

Illusions such as these disturb nobody as long as the "mistake" has an actual basis that other people can see. But when the intra-organic state dominates the situation so completely that the response occurs with no external conditions to justify it, we say that the person is suffering from *delusions* or *hallucinations*.* When the same delusion persists for long periods of time and the individual builds up a whole series of responses that correspond to it, we say that he has *systematized delusions*. Every hospital for mental diseases has many patients belonging to this class. These delusions take many forms. Delusions of persecution and delusions of grandeur are among the most common.

A woman of about thirty-five years, a graduate student in one of the leading American universities approached a group of her classmates one day with the remark, "I wonder whether studying psychology makes people selfish or whether selfish people are more likely to choose psychology as a major." When asked for an explanation she continued, "Never in my life have I been so unkindly treated as I have

* The term *hallucination* refers particularly to false perceptions that have, as far as other people can see, no basis in objective reality. Although hallucinations occur in all sensory fields, those of vision and hearing are the most common. The patient suffering from delirium tremens sees snakes, rats, mice, and other vermin; the paranoid hears voices reproaching him for his sins or urging him to crime. *Delusions* are more highly organized than hallucinations; they are systems of belief, usually centering about the person himself. The patient believes himself to be Napoleon, or to be incredibly rich, or to be the object of some great conspiracy.

Hallucinations may arise directly from a disturbed condition of the body, such as is produced by certain drugs or by fever. There is a plant known as *mescal* that grows in the southwestern part of the United States and which, when taken into the body, produces visual hallucinations that are remarkable for their color qualities. In delirium the fevered patient both sees and hears many things that are not there. Prolonged alcoholic poisoning seems to have a particular effect upon the visual centers in the brain, predisposing the patient to see small things in motion. Hence the hallucinations of delirium tremens are likely to take the form of small animals such as mice or insects.

been here. I have been absent from class for the last three lectures and not one person has asked why. No one has even offered to lend me his lecture notes. But," she went on, illogically enough in view of her previous remark, "that is always the way. No one ever tries to do anything for me."

At this point some one reminded her that she could not have been absent for more than the opening lecture as she had just come from class and there had been but one previous class meeting. She was offered the use of notes on the first lecture but declined them indignantly, insisting that there had been several lectures and that the students were maliciously withholding their notes from her in order that she might be made to fail in the course.

A few days later she accosted one of the same students in the hall and began to tell a long story about her brother who had, she said, been an officer in the World War and was murdered during his sleep by one of his brother officers because of jealousy over his more rapid promotion. In the midst of the recital she suddenly stopped, walked rapidly up the hall, stared intently for a moment at one of a group of men students, then returned and in a dramatic whisper inquired, "Do you see that man up there? That one with his back to us? He is the one. He is the man that murdered my brother!" Dropping her tone to a still more melodramatic pitch she added, *"But I'll get him yet!"*

By this time the students were convinced that here was a case of definite mental disorder. They reported it to the faculty but before action could be taken, the woman amazed everybody by getting up in the middle of a peaceful lecture to accuse one of the students of having stolen her brief-case. (No one, it may be noted, had ever seen her carrying a brief-case.) The theft had been done, so she claimed, at the instigation of one of the professors who wanted to secure her notes on a scientific investigation she was making. She explained that, if completed, this research would undoubtedly so revolutionize psychology that no one now engaged in it would be able to hold his position.

Here we have a striking example of the type of mental disorder which is known as *paranoia.* It is characterized by

systematized delusions centering around ideas of persecution. As a rule, grandiose ideas are mingled with it. The persecutions are rarely of a trivial nature but in most cases, as in this one, a reason is assigned for them that enhances the patient's importance. Auditory hallucinations are very common in paranoia. The patient "hears voices" which in some cases are referred to particular sources as angels or devils or even God, by others are simply called "voices." At first the voices are often confused, and the patient himself can distinguish very little that they say. As the disease progresses the words become clearer, and the patient often feels impelled to act in accordance with their advice.

The progress from the normal to the abnormal is well exemplified by paranoia. There is no clear boundary here between the sane and the insane; the one merges into the other by imperceptible stages.* Often no one realizes that anything serious is wrong until some spectacular action or remark on the part of the patient calls attention to his condition. Many true paranoiacs never find their way into hospitals but remain in society where they not infrequently cause much trouble by casting unwarranted suspicion on others. The "poison pen" letters, filled with malicious accusations, that every now and then threaten to disrupt a community are often the work of some unrecognized paranoiac.

It is probably safe to say that at the root of every case of paranoia lies a mental conflict of some kind, a motive that cannot be carried out to its normal termination in sat-

* Most paranoiacs are entirely sane on all topics that do not impinge upon their particular system of delusions. Until the condition becomes so far advanced that the delusions dominate all his thoughts and actions leaving no time free for anything else, the typical paranoiac is able to carry on his usual work, talks sensibly about everything outside the delusionary field, and shows no evidence of general mental deterioration. For this reason it is hard for friends and relatives to believe that anything is seriously wrong. The graduate student described above was doing excellent work in all her courses, was well informed on topics of the day and had rather more than an amateur knowledge of art, especially etchings.

isfying overt action. The individual's ambition may be greater than his power to accomplish, or circumstances may combine to prevent him from fulfilling some deep-lying desire. The well-known "old maid's complex" is an example. A woman who has passed her youth and realizes that her chances for matrimony are few finds herself in a difficult position. The social taboo which says that women must be the sought and not the seekers prevents her from making an open and unabashed effort to secure a husband, and she is embarrassed by the fact that men pay so little attention to her. A solution offers itself that partially satisfies her pride. She will avoid men. But avoiding men who are only too eager to be avoided does not satisfy her needs, for what she is seeking is an explanation for her lack of masculine attention in terms other than her own lack of attractiveness. So she begins to find an outlet in telling her friends about the men who from time to time have tried to force their attentions upon her. At first she probably knows, if she would permit herself to face the matter, that these tales have little foundation in fact so she tries to lend them verisimilitude and so make them more satisfactory to herself by watching the men whom she meets and trying to find something in their behavior that might be interpreted as having special reference to herself. As time passes she finds that less and less is needed in the way of objective reality to make such an interpretation seem reasonable to her. Here again we have an example of the working out of Hollingworth's principle of redintegration. As learning progresses, smaller and smaller cues are needed to reconstruct the whole.

In the majority of cases the matter ends there. The woman's stories may grow a bit taller as time goes on; she may become a little more careless about discrepancies in their detail as the whole thing takes on reality for herself but that is all. Occasionally, however, particularly among

women who have few other interests to take up their time and attention, a more serious state of affairs develops which may pass over into genuine paranoia. The habits of make-believe are transformed into a series of systematized delusions. The woman now really believes that she is constantly being pursued by men with amatory intentions. Perhaps her delusions center around some particular man. A good many domestic complications have arisen when some unfortunate husband has been selected to play the stellar rôle in such a system of delusions. She may write him protesting notes or even denounce him to her friends and to the police.

The graduate student who claimed that her brief-case had been stolen is another case in point. This is another instance where a strong motive that could not entirely complete itself in objective action succeeded in finding a substitute in phantasy that eventually became completely divorced from reality. Undoubtedly this student would have liked (as who of us would not!) to make a scientific discovery that would revolutionize society. But most of us manage to keep our feet on the ground and to find satisfaction in taking whatever halting steps our ability permits toward the goal we set for ourselves.

When there is conflict between motives and objective reality, a solution is sometimes found in a physical symptom of some kind. A young woman was engaged to be married to a man who lived next door to her and whom she had known since childhood. One day the man came home, bringing with him another girl whom he introduced to his amazed family as his wife. They had been married that day. When his jilted sweetheart was told of the marriage she was greatly upset, and in the midst of her tears she exclaimed, "I will never go there to call on her. Never!" A day or so later she was taken ill, and it was soon discovered that a paralysis had developed in both legs. The

relationship here is fairly obvious. She would not go, hence it was necessary for something to happen that would make it impossible for her to go. Such cases are not infrequent.

Taking refuge in a physical symptom in order to avoid a difficulty or to find a solution for a conflict, to get attention, or to secure revenge, is known as *hysteria*. At first thought it seems as if the patient were just pretending to be sick, but in true hysteria this is not the case. The patient has deluded himself so thoroughly that to all intents and purposes he is as sick as he thinks himself to be. Of course there are many cases in which the illness is pure make-believe, and it is probable that in most instances the device, which is adopted more or less intentionally in the beginning, later progresses to a stage where it takes on a character of reality to the patient. The physical symptoms assumed by the hysterical patient cover almost the entire range of human diseases. Hysterical blindness, deafness, mutism, and cardiac disturbances are very common. Hysterical disorders differ from the true illnesses which they simulate in various ways as a result of the fact that the average person's medical and anatomical knowledge is not very exact and his symptoms follow the line of his misinformation. For example, people sometimes report complete loss of sensitivity in a hand or other local part. That this is more than just make-believe can be shown by pricking the affected region with needles, scorching the skin, or other tests that normally would cause much pain. The hysterical patient pays no attention, continuing to insist that he can feel nothing. But the hysterical nature of the symptom appears in the fact that while true anesthesia follows the course of the nerves, in the majority of cases hysterical anesthesia does not. Most people think of the body as divided up into such segments as arms, legs, hands or head, and if they seek a way out of some overwhelming difficulty by means of a bodily ailment they naturally enough locate the ailment in what, to them,

constitutes a "part" of the body. So the hysterical person may exhibit complete anesthesia in a hand but the insensitive region stops short at the wrist and the arm above the wrist shows normal sensitivity. If the trouble were with the nerves this would not be the case. (See Figure 79.)

Hysteria, like paranoia, is not sharply marked off from less pronounced states which do not prevent the patient from passing as normal though they greatly interfere with his efficiency. Getting sick as a way out of a difficulty is a device that children learn early and that many adults continue to find useful. Note, however, that neither the child nor the adult admits the device to himself. Usually if you examine your feelings with care it is possible to locate something that with a little encouragement can be made to feel like a pain. It is not hard to imagine that you have difficulty in moving your arms and legs, and, if you do not move them for a period of days or weeks, a genuine difficulty ensues as a consequence of the prolonged inactivity. Hysterical paralysis does not become genuine paralysis but it does, in time, lead to a state in which movement becomes increasingly difficult.

Manic-depressive insanity is a form of mental disorder which again is only an exaggerated form of behavior tendencies shown by normal persons. Everybody is subject to fluctuations in mood. Sometimes you feel happy and good-natured; all the world looks rosy and it takes a good deal to depress you. At other times you feel discouraged, depressed, and nothing seems worth doing. These changes in mood are mirrored in your behavior. When you are happy you move more quickly, you attack everything you do with zest and energy. You pass readily from one activity to another because everything seems worth doing. When you are depressed you move more slowly and you tend to plug along at the same kind of thing because nothing is worth while anyway so why bother to change?

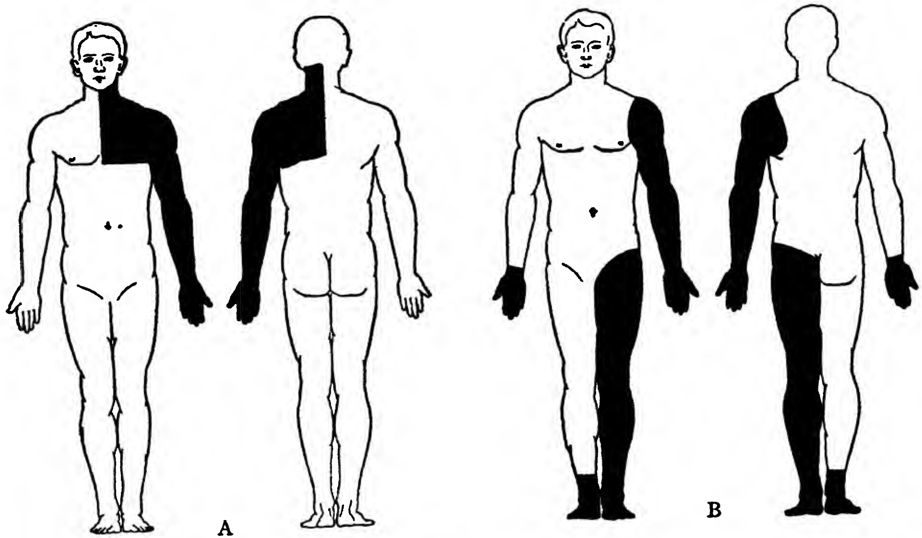

FIGURE 79

TRUE AND HYSTERICAL ANESTHESIA

A. Loss of sensitivity to pain resulting from a tumor in the cervical region of the spinal cord. (After Head and Thompson.)

B. Hysterical anesthesia of isolated parts of the body. (After illustration in Morgan's *Psychology of Abnormal People*, Longmans, Green and Co.)

Normally, such changes from elation to depression depend on two things; bodily states such as indigestion or fatigue and the external events to which the organism responds. A series of disappointments may temporarily depress the most optimistic mood; a bit of unexpected good news may do a good deal to cure an attack of the blues. But in some people these swings of mood become greatly exaggerated and dissociated from the events around them. As in paranoia, the condition is likely to develop gradually over long periods of time and only to be recognized for what it is when it reaches a very pronounced stage or when, as often happens, the person finally commits some overt act that cannot be overlooked.

Michael S. was a farmer, living in a small rural community. He was of Irish descent and had the keen sense of humor that often characterizes the Irish. At all the rural gatherings his ready wit and his high good humor were well known. As a rule, Michael was an indulgent husband and father but there were times when his mercurial spirits failed him, when he had what his kindly wife called "black days" when his farm work was neglected and his family found it wise to keep out of his sight.

This went on for many years. Every one in the neighborhood knew of these swings of mood but took them pretty much as a matter of course. For his neighbors their chief significance lay in the series of amusing stories that grew up about his behavior, such as the time when, under the influence of one of his "black spells," he left home and went to live in the woods. Michael was not a very successful farmer because when he was "feeling fine" he found so many other interesting things to do that his farm work was neglected and on his bad days he usually refused to work at all.

One day his nearest neighbor was attracted by the sound of repeated shots that came from the direction of Michael's home. At first he paid little attention to them as this was the corn-planting season when most farmers were busy shooting crows. But as the shooting continued and

became mingled with loud shouts, he became alarmed and decided he might better investigate. In front of the house he found Michael and his terrified wife. A rough race course had been outlined by means of small stones. Michael stood in the middle brandishing his shot gun and shouting wildly at his wife whom he was forcing to run at top speed around and around the course he had marked out for her. "She's too fat!" he announced excitedly to the neighbor on his arrival. "She needs exercise!" Fortunately the neighbor was an intelligent man who saw at once how matters stood. He agreed with Michael about the wife's need of exercise but called his attention to the fact that he was out of ammunition—he had been firing his shot gun into the air as a threat to his wife whenever she slackened her speed. The neighbor then offered to stand guard over the wife while Michael went to the house to get more shells. To this Michael cheerfully agreed, handing over his shot gun to the neighbor, who sent the almost exhausted wife for help. Michael was committed to the State hospital where he remained for the rest of his life. There were occasional periods of improvement, but they did not last long.

Manic-depressive insanity, like other forms of mental disorder, almost certainly has an inherited base, but whether or not the inherited predisposition will develop into an actual psychosis—that is, into a mental disorder so grave as to incapacitate the individual from living a normal life in society—probably depends in large part upon development through experience, upon the habits one forms, and upon the kind of motives by which he is activated. Not only in the manic-depressive patient, who has passed the dim boundary by which we distinguish the "normal" from the "insane," but in normal persons, belonging to the so-called "cyclothymic" type whose swings of mood are more pronounced than those of the average person, the outstanding thing we notice is that they do not seem to be directing their activities to any major purpose.. They shift about from this activity to that because there is no single direction in which

they are trying to go; no one goal that is at once remote enough and possessed of sufficient drawing power to dominate their thoughts and actions for a long period of time.

Among normal persons who have frequent changes in mood the situation may be just that they have never been stimulated to integrate their motives toward a long-time purpose. In the extreme cases, those with whom the condition passes over into a real mental disorder which prevents them from carrying on in normal society, the basis for the condition is more likely to be a mental conflict in which the patient cannot work toward the purpose he desires and will not substitute another. But the result is the same except that the behavior is given more energy by the strong motive that lies back of it. The manic does not work directly toward an end though sometimes one may see in his behavior certain trends, symbolic actions, in which his real object is not so completely concealed by his apparently trivial and aimless acts. But since he is not working toward an end, either because he does not see it or because he refuses to look at it, his behavior lacks all appearance of integration or design. It becomes flighty, unpredictable, irrational.

Take your own case. When do you find it easiest to ignore disappointments and minor annoyances, to resist the petty attractions and distractions that crop up in your way, and to keep steadily on your course without hesitation or shifting? Under what circumstances do your moods remain most stable, least affected either by your own changing physiological states or by disturbing events in the outside world? The answer is—when you are devoting all your energies to the accomplishment of some definite purpose, when you are activated by motives that are at once so intense and so strong that other matters seem, by comparison, to be of little consequence. At what times are you most subject to swings of mood? When you are at loose ends, when there

is nothing to dominate your thought and action except the immediate events going on within and around you.

The manic-depressive individual has never really grown up. He has never learned to subordinate the impulses of the moment to the needs of the future. He lives in the present. He is swung about by everything and everybody, but he is little influenced in his behavior by the wishes of other people. Like the child whom he resembles, his own momentary desires are preëminent. He sings when he is happy, shouts when he is excited, has temper-tantrums when he is angry. All his impulses discharge into activity at once; they lack both coördination and integration.

One more type of mental disorder needs to be mentioned. This is a condition now generally known as *hebephrenia* in which the patient solves his conflicts by refusing to accept any responsibility for them, by running away from them. Now the only persons who, by common consent, are not held responsible for their actions are children and idiots. So the hebephrenic acts like a child or an idiot. Some carry the regression further than others. It may extend only to the period of early childhood in which case the patient runs about, perhaps talks with a babyish accent, plays with childish toys and picture books and demands the privileges of childhood in the attention of other people and in the free expression of his own emotions. Sometimes the regression progresses to a deeper level. It may go back to early infancy. In such cases the patient becomes unable to feed himself, he may lose control of his bladder and bowels, speech is replaced by babbling and crying, the prenatal posture may be habitually assumed (and we can see now that this does not necessarily indicate any recollection of his own prenatal life * but is far more likely to come about through the imitation of other babies whom he has seen and whose rôle he is now assuming).

* See p. 111.

Hebephrenia, like the other conditions we have been considering, has its milder forms within the so-called "normal" range. Here is a married woman who is unwilling to assume the duties and responsibilities of her position. She craves the indulgence, the spoiling, the petting that go with childhood. So she insists upon acting like a child. Dickens' *Dora* is a classic example. Often such women combine their hebephrenic tendencies with behavior of the hysteric type. When they cannot get their way by pouting and coaxing, they resort to the other device of spoiled children. They become sick.

The mental disorders we have described here do not, by any means, provide a complete picture of mental disease. They are examples only. They have been selected because they illustrate how human personality in its development may learn to adjust to its immediate difficulties at the cost of future disaster. In the paranoiac, we see how the child who learns to compensate for his disappointments through daydreaming, who learns to project his wishes and phantasies into the external world until he sees in the behavior of others the things that actually exist only in his own mind, who learns to rationalize his failures by referring them to an imaginary system of persecution may, as his responsibilities increase with adult life, take refuge in a series of delusions where he can no longer distinguish between fact and fancy. By so doing he has protected his self-esteem, but he has lost everything else. The hysterical person adopts a different device. He makes physical disability his excuse and protects his pride by a physical handicap that is always serious (otherwise it would not fulfill its purpose) and that often means chronic invalidism. The hebephrenic escapes *in toto*. The paranoiac and the hysterical person retain certain aspects of their personality intact but the hebephrenic sacrifices everything rather than face his difficulties.

The manic-depressive chooses another method. Like the

others he has difficulties of his own, a mental conflict of some kind that he is unwilling to face. We said in a previous section that his behavior is not governed by any real purpose. This is not because he has no purpose but because the purpose that he would choose, if he could, is for some reason barred to him, and so he refuses to acknowledge it or to do anything that seems directly related to it. But while the paranoiac takes refuge in dreams, the hysterical in sickness, and the hebephrenic in childhood, the manic takes refuge in reality. He cannot work to an end, so he expends his energy on trivialities. He hails with relief anything that will help to keep his eyes away from the forbidden goal. At times the insignificance and worthlessness of all his actions overwhelms him, and then he sinks into the depressed phase. But even in his depression he must not think of his real trouble. He broods over this and that. Sometimes he seizes upon some definite thing to worry about—something, it may be noted, that as a rule is quite trivial, but which he magnifies into terrific proportions. Having this to occupy his mind he need not think of the other. If one has to worry, it is better to choose a subject that is not too painful.

Heredity Versus Habit as Factors in Mental Disease

There can be no question that some persons, because of inherited predisposition, will suffer mental breakdown under conditions to which the more fortunately endowed would not succumb. The functional mental diseases occur in certain families so much more frequently than in others as to leave little doubt that a constitutional factor is involved in a large proportion of the cases. Nevertheless, as we have pointed out before, the presence of an inherited tendency is rarely, if ever, sufficient to induce a mental breakdown in persons who from the beginning have formed the kind of habits that make for mental health. Those who meet their difficulties squarely; recognize them for what they are; and,

if they cannot overcome them, at least find a way of adjusting to them that does not interfere with a normal life in a world of action are in little danger of mental breakdown.

Mental disease is in large part a learned reaction. Just as we learn to seek food in particular ways and in particular places; to delay eating, though hungry, when circumstances make it seem better for us to do so; to try new methods of food getting when our usual habits are unsuccessful; and to repeat these methods, if we find that they work, or to substitute other less palatable foods in place of those that we are either unable to get or know that we ought not to eat—just so do we learn other habits that make for sanity or insanity. Contrary to popular opinion, people do not suddenly "go crazy." What sometimes appears to be a sudden development is usually one of two things. Either it is a final yielding of the defenses to steadily accumulating mental conflicts—the proverbial "last straw"—or, more frequently, a state that has been gradually developing over a long period of time is suddenly brought to public attention when the affected person commits some overt act that can no longer be ignored.

Can mental disease be cured? Sometimes. In many cases, however, the chief difficulty lies in the fact that the patient does not want to be cured. He is unwilling to give up his beloved symptoms through which he has found a partial solution of his difficulty. Not only that, but he has learned that in these symptoms, whatever they may be, lies a way out of other difficulties that may develop later. So, even if it is possible to find out what caused the original conflict and to remove that particular trouble, when something else comes up the patient is likely to respond in the same old way. And the difficulty cannot always be removed, even if we find out where it lies. Some conditions cannot be changed, and when these conditions lie in the way of complete satisfaction of normal motives an adjustment must be

made. In order to maintain the personality intact, this adjustment must involve the entire personality. The best way is to find a new purpose, one to which all one's efforts can be directed without running foul of the obstruction, provided always that the obstruction is one that cannot be mastered by direct attack. But some persons refuse to do this. Instead, to use Bleuler's telling phrase, they succeed in "splitting off" a part of their personality by gratifying one motive at the expense of all the rest. And even this gratification is usually a poor one. Day-dreams, the protected life of an invalid, or the shallow amusements of a pseudo-childhood offer but slight return for the sacrifice of a normal life of thought and action.

Chapter XXVI

OLD AGE

About how much has the average term of life increased since the sixteenth century? What have been the chief factors contributing to this increase?

Is there a greater chance now than formerly for a man of eighty to live to be one hundred?

Do the senses other than sight and hearing show changes with age? For what distances is the visual loss greatest? For what pitches is the loss of hearing most evident?

Why do the old often remember the events of their childhood better than those that occurred more recently?

What are some of the chief mental hazards of senescence?

What can young people do to improve their chances of a useful and happy old age?

How Many Live to Be Old?

Obviously this is a question that does not admit of any precise answer unless we first decide at what age people become old. But, if we put it in other terms, and ask what are the average person's chances, under modern conditions of American life, of living to be fifty, seventy, or ninety years of age, there are statistical tables that will tell us. According to one of the most dependable of these tables,* at birth the average expectancy of life for a boy baby is about fifty years; for a girl baby it is fifty-three years. But, if the

* J. W. Glover, *United States Life Tables* (Washington: Govt. Printing Office, 1921), 496 pp.

hazards of infancy and early childhood are survived, the chances of living to be old are better. The little boy of five may expect to live to be sixty; the girl of the same age is likely to live to be sixty-two. The youth of twenty may

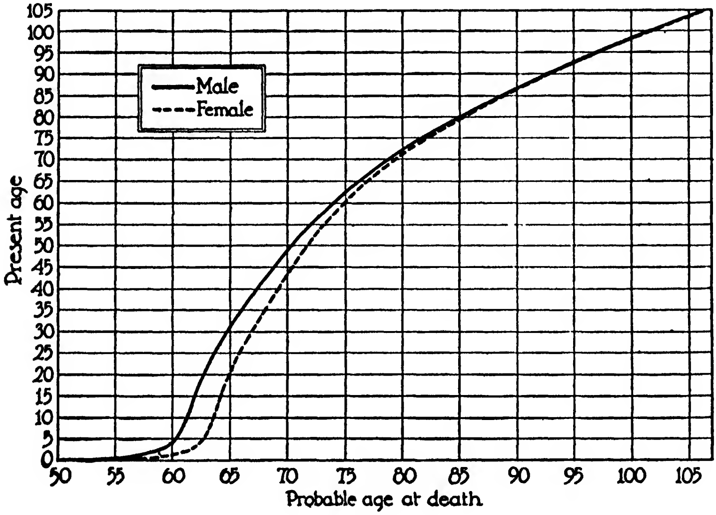

FIGURE 80

EXPECTATION OF LIFE AT ANY GIVEN AGE

To find your most probable age at death first locate your present age in the column of figures at the left. Read across to the intersection of your age line with the curve for your sex. The numbers along the abscissa show your most probable age at death.
(Based upon Glover's life tables for whites in the registration area of the United States.)

look forward to becoming sixty-two; at the same age his sister may expect to reach the age of sixty-five.

The average duration of life has been steadily increasing for several centuries. There are no very good figures to tell us just what was the average age at death three or four hundred years ago, but most authorities are of the opinion that in the sixteenth century at least half the population,

on the average, died before the age of twenty. Since then the average age at death has moved constantly upward until, in the United States at present, more than half live to be sixty or older.*

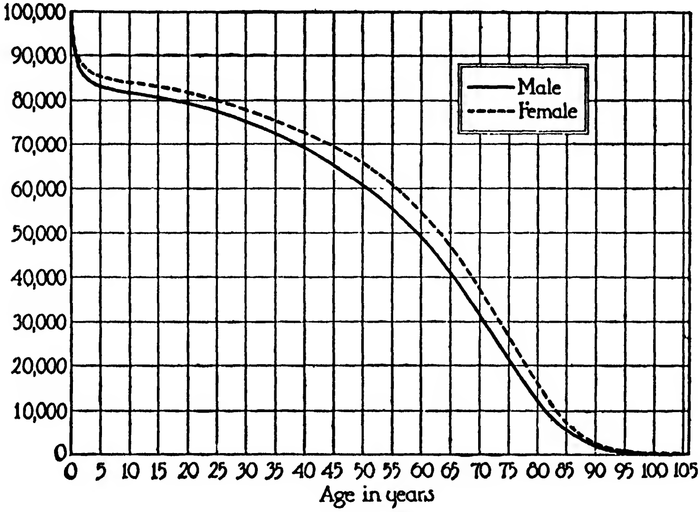

FIGURE 81

PERCENTAGE OF THE TOTAL NUMBER OF LIVE BIRTHS THAT SURVIVE TO ANY SPECIFIED AGE

(Based upon Glover's life tables for whites in the registration area of the United States)

A number of people have been so much impressed by this increase in the average life span that they have built up lively hopes of continuing the increase to a point at which human life would be extended to a far greater age than we know now. But these persons have failed to take into account a very important fact. The increase in average

* The average expectation of life at the time of birth is not the same thing as the average age at which half the population born are still living because death-rates in the later years are so much more rapid than they are in the early years (see Figure 81).

duration of life has not been brought about by lengthening it equally all along the line, but instead it is almost wholly due to medical discoveries and improvements in sanitary conditions which have increased our control over certain diseases from which many people formerly died. Smallpox and yellow fever, which a century or two ago took the lives of thousands, are examples. As a result of better natal and prenatal care, the reduction in infant mortality has been very great, and the death hazard has also been much reduced among children and young adults. Among the middle-aged, too, the expectation of life has somewhat increased. But among the old, little or nothing has been added to life expectancy. Apparently the man who attained his seventieth birthday in the year 1800 had almost as good a chance to live to the age of ninety as he would have to-day. The average span of life has increased, not because the old live to be older but because a greater number of the young live to be old.

Since so many of the young people of to-day will in the course of time become old, the psychology of the declining years is an important study for them as well as for their elders who are already beginning the descent. Moreover, since the number of old people in society is on the increase, the importance of understanding them and of providing for their psychological as well as for their physical needs is evident. Let us first consider the physical infirmities that come with advancing years.

The Physical Handicaps of Old Age

The changes in appearance that mark the years are so well known that they require only brief mention. The wrinkles, the graying hair, the stooping shoulders are familiar to all of us. There is a general loss of resilience in all the bodily tissues. The bones become more brittle, the amount of connective tissue in the muscles increases at the ex-

pense of muscle fibers, giving to the limbs the knotted and stringy appearance that is characteristic of old age. The brain slowly decreases in weight. In the brain as well as in the muscles, the supporting tissues increase in amount while the functional cells, particularly among the very old, are likely to degenerate. Increase in connective tissue and often of fat in and about the heart makes it necessary for the organ to enlarge its size in order to do its work. The gradual stiffening of the arteries adds to the cardiac strain. Many changes also take place in the ductless glands. At about the age of forty-five in women and several years later in men the reproductive capacity ceases.

Automatic regulation of bodily functions no longer takes place so promptly. The old "feel the cold more" because heat losses are not so quickly made good. If, through unexpected exertion, they become out of breath, it takes a longer time for the breathing and heart rate to get back to normal. Other regulatory responses show a similar drag.

All the senses usually show a loss of acuity. We are familiar with the fact that the old usually suffer some impairment of sight and hearing. The visual deficiency is commonly greatest for near objects through loss of elasticity in the lens which can no longer become sufficiently convex for adequate near vision. This causes the "far-sightedness" of old age. Sometimes people who have been near-sighted in youth pass through a period of approximately normal vision on reaching an age when the increasing far-sightedness that comes with years is just enough to compensate for the earlier defect. Loss of hearing in the old is usually greatest for the higher pitches. Drying and hardening of the skin results in loss of sensitivity to touch. Changes in the sense of taste also occur. The taste-buds on the top of the tongue gradually atrophy. Beginning at the tip of the tongue the insensitive area extends further and further toward the back as age advances. Taste buds on the inner surface of the

cheeks also become fewer. The old often complain that "nothing tastes like it used to." Since the olfactory senses, too, usually become less acute in old age and since as we have seen foods owe much of their flavor to the sense of smell, dullness of the olfactory organs is a contributing factor here.

The breaking down of motor skills proceeds in inverse order from that in which the skills were developed. The fine coördinations which were the last to appear are the first to be lost. The same rule is very noticeable in the field of memory. Old associations persist, new ones disappear. The very old often remember the events of their childhood, while they forget those of yesterday. Undoubtedly the principle of overlearning plays a part in this selective forgetting, but it is possible that the unknown physiological changes that form the basis of learning may become less stable as age progresses, thus making for quicker forgetting of material learned during the later years.

Changes in the mental abilities of the aged were described in Chapter XXIV and need not be repeated here. We shall only note, by way of summary that, if we make a rough division of activities into three classes,—perceptual, motor, and intellectual—investigation seems to show that the perceptual skills which are most directly dependent on the functioning of the sense organs are the ones that show the earliest and most rapid decline. Motor skills come next, while the intellectual functions are the last to show marked decrement.

Mental Hazards of Increasing Age

During late middle-age at about the close of the reproductive period, some persons become greatly depressed, worried, and anxious. In extreme cases their condition closely resembles the depressed phase of manic-depressive insanity, and may necessitate their removal to a hospital for mental

diseases. This condition is known as *involutional melancholia.* There is reason to think that, although the condition may be precipitated by the physiological adjustments that have to be made at this time, the primary cause is usually a mental conflict or a series of mental conflicts which are brought to a focus by the objective evidence that youth is now a thing of the past. Other factors often play a part. In business and professional life older men may feel themselves to be at a standstill, while younger men forge ahead of them. At this time, too, many parents have a hard struggle to adapt themselves to the fact that their children are growing up and are no longer chiefly dependent upon them for affection. All this leads to a hopeless feeling that life is no longer worth the living. In the extreme depression that follows, actual or attempted suicide is fairly common, and it is often such an attempt that first calls attention to the seriousness of the mental state.

Senile dementia as its name implies, is a disease of the aged, but the actual ages of its victims vary greatly. Some people become old much younger than others. It is physiological age rather than actual years that counts. Although senile dementia is an organic disease in the sense that gross changes in brain tissue are usually involved, it is not improbable that persons who have kept up an active interest in life resist these changes and maintain an integrated pattern of behavior for a longer period than those whose habits of thought and action have previously been allowed to shrink into a narrow groove.

The senile dement typically becomes like a child. Occasionally, particularly among men, the earlier stages are accompanied by delusions of a return of young manhood. The man of seventy-five falls in love with a girl of sixteen and pursues her with ardent attentions. As the condition progresses, however, the patient becomes increasingly childish in his behavior, his mind wanders, he gradually loses

control of his bodily functions, and at the last may have to be cared for like an infant.

The Mental Hygiene of Old Age

As their senses grow duller, the old are more and more completely cut off from the world around them. Particularly is this true of those who suffer complete or nearly complete loss of hearing. The young often complain that old people are self-centered, that they think and talk only about themselves. One reason for this is unquestionably to be found in the increasing isolation that comes with sensory deprivation. Old people think and talk about themselves because they no longer have the means of finding out very much about what is going on around them. One of the most important aspects of the mental hygiene of old age is, therefore, to use every possible artificial aid to compensate for the increasing sensory weakness. The need for financial preparation for the years when self-support becomes difficult or impossible can hardly be overstressed. Problems relating to old-age insurance, retirement annuities, old-age pensions and the like are among the most vital social questions of to-day. But there is another hardly less important form of old-age insurance about which we hear little. In addition to financial preparation for the declining years, every young person should see to it that he acquires a store of interests, skills, friendships, and life objectives that will outlast his youth. Some people, no matter what their years, never seem to grow old in spirit. These are the ones who have laid up for themselves a store of all-engrossing occupations with which to fill the gaps that inevitably occur with the passage of time. Just as in youth we prepare for the work of maturity, so in maturity some thought should be given to the activities of old age. Most fortunate are they whose life occupations are of a kind that can be continued into old age, for they are the ones from whom the years exact least

in the way of adjustment. Edison, Luther Burbank, Justice Holmes, and others who continued to do productive work for years after most people find it necessary to stop, escaped many of the most trying situations of old age. The years bear heaviest upon those to whom they bring an enforced leisure with nothing to fill it that seems worth the doing.

Many of the personality changes that so often come with age—the increased irritability, the self-centeredness, the tendency to magnify bodily ills which sometimes amounts to genuine hypochondria *—are less the direct result of age than the sense of discouragement and frustration that comes from a realization of increasing inability to do the things that were formerly done. We saw in the last chapter how conflicting impulses or continued frustration may find an abnormal outlet in behavior that in extreme cases leads to complete disintegration of the personality. But old age does not always bring frustration. To some it means increased leisure for the development of long-treasured hobbies and interests and this is as it ideally should be. Not all forms of ability decline at an equal rate, and as was pointed out in Chapter XXIV, most abilities decline slowly enough to enable the old to participate in many activities with enjoyment and profit, if they care to do so. But although the old may continue to carry on the activities of their youth with but slightly abated ardor as long as their physical and mental condition permits, they are not facile in developing new interests. They may renew old hobbies or take advantage of increasing leisure to do some of the many things for which a busy maturity left too little time. But these interests and hobbies must in the main be drawn from the reserves that were accumulated earlier. Too many old people, when confronted with the new leisure that is thrust upon them with

* The term *hypochondria* refers to a tendency to magnify bodily ills out of all proportion to their true significance.

the years, find that they have no psychological reserves from which to fill it.

Senescence, which Hall so aptly calls "the youth of old age" is a time when a new kind of psychological weaning must take place if the years that follow are to be satisfying. The adolescent must free himself from emotional dependence upon his parents; the senescent in like manner must free himself from emotional dependence upon his own youth. Each age has its own satisfactions for the person who will take them. Growing old is as normal a part of life as growing up. In age, as well as in youth, the well-integrated personality lives in the present and plans for the future.

Chapter XXVII

A BACKWARD LOOK

Under what circumstances would you say that a given individual has made a successful adjustment to his environment?

What factors play a part in determining whether or not a successful adjustment will be attained?

Science and Human Welfare

Although science begins with observation and description, it is not satisfied merely with accounts of isolated phenomena as they chance to occur. It aims to coördinate its observations in such a way that from the occurrence of an event or series of events we can make valid inferences about what happened before and what is likely to happen afterward. The astronomer predicts when an eclipse of the sun will occur and on what part of the earth the shadow will fall. The engineer predicts that a certain bar of steel will break under a given strain. With less certainty the physician predicts the course of disease, prophesying how long it will take for a sickness to reach its crisis and what are the chances for recovery. He also predicts that, if certain things are done, the likelihood of recovery will be increased.

Nowhere is the question of prediction more vitally important than in the field of human behavior. We live in a world of human institutions, of human industry, of human relationships. Science has taught us to harness the forces of nature to the demands of human comfort and convenience.

It has given us railroads, telephones, automobiles, electric ice-boxes. It captures a ray from distant Arcturus to light the lamps at the Century of Progress Exposition; it enables the lonely Iowa farmer, by the twirling of a dial, to listen to a concert by a Boston orchestra, an address by a statesman in London, or jazz from a New York cabaret. From birth to death there is hardly a moment of our lives in which we are not making use of some product of industrial science and art. In physics, in chemistry, in engineering, in medicine, and the biological sciences tremendous progress has been made. But our knowledge of human nature has lagged far behind our knowledge of inanimate nature. The engineer who can turn rivers from their courses, who can transform the energy of the waterfall into light for a city hundreds of miles away is baffled by a child's temper-tantrum. The mathematician who attacks the most difficult problems of the calculus without hesitation may be so unable to solve the riddles of his own personality that he has to be placed in a hospital for mental disease. Nations can destroy each other, but they cannot understand each other.

We need to find out how to get along with ourselves and with our neighbors, who, under modern conditions of transportation, are rapidly coming to include the entire population of the globe. In such a crowd we are likely to be run down and crushed, if we do not learn the traffic regulations. The more complex the social organization, the greater are the problems of individual adjustment. If our progress in the mechanical arts is to yield us its full benefit, we must develop a science of human engineering to keep pace with it.

One reason why progress in the study of human behavior has been slower than progress in the physical sciences is the fact that crucial experiments are in so many cases forbidden to us. We cannot take a baby and operate on various parts of his brain to find out what will be the effect upon his behavior; we cannot deliberately take a group of boys from

good families and put them to live in a delinquency area, while we remove another group of the same age from the delinquency area and place them in the homes from which our first group came. Even when experiments are likely to be beneficial, the difficulties do not disappear. We cannot, at will, take children out of the environment in which they have been reared and place them in foster-homes whenever we have reason to think that the change would be to their advantage.

The chemist is free to try practically any experiment that seems desirable to him. He can vary his conditions at will. He can be sure that in the intervals between trials his chemicals are safely housed in their own bottles and jars on his laboratory shelves where nothing can happen to them. But the psychologist with human beings for his chemicals is in a very different position. Not only are many of the experiments that would add most to his knowledge completely out of the question, but he is forced to work with materials of whose individual idiosyncrasies he knows but little, whose nature is constantly changing with the passage of time, and which are being subjected to all sorts of unknown conditions during the hours when they are not with him. When we consider the complexity of the problems he is trying to solve and his very limited facilities for solving them, the wonder is not that the psychologist has made so little progress but rather that he has succeeded in finding out as much as he has.

But although we may not make certain experiments ourselves, chance and social conditions are constantly making them for us. We cannot place our subjects in any kind of environment we choose in order to see what happens, but social conditions may do this for us. We would not purposely induce sickness or accident in order to study their effects upon behavior, but sickness and accidents occur, whether we wish it or not, and as they occur we can study

their psychological effects. We cannot make the same kind of breeding experiments with human beings that are made with animals, but we can study the outcome of such matings as naturally occur. The scientific progress that is made under these rather hap-hazard conditions is much slower than it would be if we could take matters into our own hands not only because we have to waste so much time in waiting but also because we do not know in advance when the requisite accidental conditions will occur nor whom they will affect. From lack of such advance information we are often unable to begin the study of our subjects early enough and so, although we may find out what they are like afterward, we do not know what they may have been like before the special conditions were operative. We are in much the same position as the chemist would be if another person with little chemical training were to carry out his experiments for him in such a way that, although the chemist himself could study the outcome of the experiments at his leisure, he could find out very little about what chemicals were originally used or exactly how they had been combined.

Minor experiments, to be sure, can be carried out in the laboratory under fairly well-controlled conditions. Animal experiments, where more liberty is permitted the investigator, have taught us much about the characteristics of the higher animal we call man. But if we wish to understand human nature from its beginnings, if we are interested in knowing not merely how people act but why they act as they do, if, in a word, we hope to make psychology contribute to human welfare and individual happiness to an extent that is comparable with other sciences, then we must cease to content ourselves with little studies of isolated bits of behavior and turn to the major problems of differential development under varying conditions over long periods of time. A single swallow does not make a summer, and a single event does not determine whether a given child will

develop into a genius or a criminal or a hobo. Intelligent control of human behavior is impossible without knowing what results are likely to follow when a particular kind of organism is subjected to a given set of conditions and how lasting these results are likely to be. To answer this question we must begin early and continue long.

In our study thus far we have tried to give a simple and non-technical account of some of the major principles of human development as they are shown under modern conditions of civilized life. In order to do this we have begun with the infant and followed his development through its rapid ascent to maturity and its slow decline to old age and death. We have seen how his behavior changes with the years and with the changing circumstances that come with the passage of time. We have noted some of the many ways in which people differ from each other and have pointed out some of the circumstances that give rise to such differences. Throughout, we have emphasized the personal and social aspects of human life and behavior rather than the sensory and perceptual reactions with which the psychologists of an earlier day were so largely concerned. We have followed this plan in the belief that the beginner will be able to see a closer and more vital relationship between these forms of behavior and the experiences of his own everyday life than he would be able to find in the more precise and carefully controlled studies of sensory perception, speed of motor reaction, and similar problems that may engage the attention of the advanced student.

Even so, we have covered a good deal of ground in a short time. Our babies have grown so fast and changed so rapidly that we may well be pardoned if we feel a little confused and uncertain about how it all happened. Now that we have come to the end of the journey it is worth while for us to spend a little time in reconstructing the main events of the trip. One of the things that has particularly

impressed us all along is the fact that our babies, who seemed so much alike at first, have grown increasingly different with the passage of time. Some have turned out to be geniuses, others have become honest and contented laborers; some have become criminals and others hoboes. Some have continued to lead useful and busy lives to the time of their death; others have broken under the strain and ended their lives in hospitals for the mentally diseased. Now that we have watched these differences as they develop, let us see if by organizing our observations we can get a clearer idea of the way in which the same principles of development and learning can yield such widely differing results.

Organic Limitations to Individual Variation

First of all, we have seen that there are certain developmental tendencies that are common to all organisms of a given class. The human being, as it develops from the fertilized human ovum, grows to have arms, legs, and other physical features that are different from those of a dog or a cat. We do not know what these developmental tendencies are. We can only describe them in terms of their results; we can only say that it is the nature of particular organisms to develop in particular ways under ordinary environmental conditions. In like manner each organism, as it develops, tends to function in particular ways, and again we cannot say why, except that it is its nature to do so.

But these tendencies that characterize the organism, the tendencies that cause men to differ from rats, and rats to differ from robins, are not exactly the same for all members of a given class. Men are not all alike, neither are all rats or all robins the same. Human beings are first of all subdivided into different races—the Negro race, the Mongolian races, the Caucasian race. The members of these races are not alike physically, and they probably differ to some extent in their mental characteristics as well. The sexes also differ

from each other in a number of ways both in man and animal. And finally there are further differences, also inherent in the nature of the organism, that are the result of immediate heredity, of differences in the genes received from the parents.

None of these tendencies is absolute. Each has its own range of possible variation. Sometimes, as in the case of eye-color, the range is small. The native tendencies handed down in the genes work out in about the same way under all ordinary circumstances. Sometimes the limits of variation for the individual are large, approaching the limits found for the class. Weight is an example. People inherit a tendency to be fat or thin, just as they inherit a tendency to have blue eyes or brown eyes. But weight is not so closely limited by heredity as eye-color. A person with a tendency to be overweight can do something about it by dieting, and a proper diet will likewise help to increase the weight of the person who is by nature inclined to be thin. Heredity, the original nature of the organism, fixes certain limits beyond which variation is unlikely to occur. But few characteristics are absolutely fixed by heredity. Practically all admit of some variation.

We may look at the matter in another way. The manner in which a given organism is most likely to develop depends not only upon his inherited tendencies but also upon the likelihood that the particular conditions which would give rise to variation will actually occur under ordinary conditions of life. Experimental embryology has shown that by tampering with the organism at a very early stage of development it is possible to produce monsters of many kinds. For example, by artificially changing the position of certain primitive cells it is possible to cause an animal that normally has two eyes to develop into a Cyclops with only a single eye in the middle of its forehead. Now if the particular conditions that cause the organism to develop in that manner

were of common occurrence we should have many one-eyed animals. We should regard it as no more remarkable that some animals of a given species should have one eye and others two than that some human beings have blue eyes and others brown. The reason we do not often meet with this condition is not because the organism is incapable of that form of growth, but because the circumstances which would cause it to grow in that manner rarely occur.

From the very moment of conception, therefore, no two organisms are exactly alike, and as they grow they are subjected to varying conditions which further increase the differences between them. But before birth the external conditions by which development is affected are usually much more nearly the same for all organisms than those which occur after birth, and as a result new-born babies look and act much more nearly alike than do grown men.

The Limits of Variation in Behavior

The behavior of the human being at any stage of his growth is also limited both by the nature of the organism and by the presence or absence of factors that modify behavior. We have no way of knowing how great might be the changes in behavior that would be produced by modifying the environment in ways that have not yet been tried, but we do have a general knowledge of the extent of the individual differences that occur under the conditions of life with which we are familiar. Some children grow faster than others but the differences in rate of growth fall within certain limits. This is as true of mental growth as it is of physical growth. A child of three may have the mental development of the average child of four or five, but there is no case on record of a three-year-old whose general mental level was equal to that of the average eight-year-old. The same is true of other aspects of behavior. There is variation from one individual to another but only within limits.

In the case of physical structure we know that extreme changes can only be produced early, before the transformation of primitive cells into specialized tissue has progressed very far. Some people have taken the same view with respect to behavior. According to them the personality of an individual is "set" very early in life—the exact age has been put at anywhere from two to seven years—after which no further changes of importance take place. Although there is reason to think that the early years are the most important for modifying certain aspects of behavior, more recent investigations, such as those described in Chapter XXIV, indicate that maturity rather than childhood is the optimum time for learning many kinds of things. It is probably true that reactions of certain kinds, such as the tendency to yield to a difficulty, to overcome it or to run away from it, as well as many of our attitudes toward people, are formed very early in life. In the course of time through continued practice they become so greatly overlearned that the habits thus formed are hard to break. Perhaps adults would always learn more easily than children if they could start at the same point, if, in other words, they were not handicapped in learning new habits by having previously learned others that interfere with the formation of the new. If children had no more opportunity to learn habits of reacting to other people than the average child has of learning Esperanto, we might find that, even in regard to social attitudes and behavior, adults learn more easily than children. The same is true of emotional responses. The popular idea that the child is more plastic than the adult may have sprung chiefly from the fact that habits formed in childhood have a longer time ahead of them during which they may be practised. If we define the age of greatest plasticity as the time when new habits can be formed most readily and those that have already received a stated amount of practice (an amount which is made equal for all subjects regardless of their age)

can be most easily broken up, the work of Thorndike, Miles, Jones, and others suggests that the end of adolescence or the beginning of maturity may be the time when real plasticity reaches its peak and that the apparently greater modifiability of the young child is only an artifact resulting from the fact that habits learned in childhood are practised for a longer time. Another factor that makes it harder for adults to learn new habits of social and emotional reactions is the fact that they have learned to find satisfaction through their old habits. To set up new devices for gaining these satisfactions, even though the new ones may be better than the old, usually means some delay and consequent annoyance in the beginning, and so many people are loath to make a start.

The Process of Learning

But even though learning may be easier at certain ages than at others, there is no age at which learning does not occur. Learning begins in infancy; it continues until death. At different ages, as we have seen, the particular devices employed for learning vary somewhat, but the fundamental principles remain the same. In any act of learning we may distinguish four stages as follows: (a) a primary condition which at that time is the normal state for the organism when at rest, (b) a disturbance of this condition which may arise either from the perception of some factor outside the organism or from a physiological change resulting from its own life processes, (c) a state of activity during which the organism continually shifts its relationship to its environment until satisfaction is attained and the disturbance disappears and (d) a return, not to the original state but to a secondary condition which differs somewhat from the first as a result of the experience which has just been undergone. This secondary state now becomes the normal resting condition for the organism, and the primary state for the next

act of learning. The measure of learning is the difference between the two conditions.

The Mechanism of Adjustment

As Cannon has shown,* within the body of each individual, there are certain mechanisms for maintaining it in a constant or normal state. The internal temperaure of the body varies but slightly in health, no matter what the surrounding temperature of the air may be. If anything happens to change the temperature, as in fever, the disturbance itself at once releases the trigger that sets the restorative mechanisms to work and the bodily activities thus aroused continue until the normal condition is restored or until death intervenes. Respiration, heart rate, waste and repair of bodily tissues all obey the general rule that bodily functions must adapt themselves to the maintenance of a constant bodily condition. To this condition of the organism, in which a fixed state is maintained by means of a series of self-regulating mechanisms, Cannon gives the name of *homeostasis.*

The process of learning may be described as progress toward a special kind of homeostasis wherein the final state which the organism seeks to maintain is one of personal satisfaction. In the beginning only a few of the infant's responses lead directly to this goal. Certain of his internal bodily mechanisms, those most necessary to maintain life, have arrived at a fair degree of self-regulation previous to birth. But for most of his responses to external conditions, the self-regulation has to be acquired. Moreover, the activities by which satisfaction is maintained have to be much more adjustable than those by which the physiological workings of the body are kept constant, because the conditions outside the body to which the organism has to adjust are so

* W. B. Cannon, *The Wisdom of the Body* (New York: Norton, 1932), 312 pp.

varied that a single method of meeting an emergency would not be enough.

The mechanism by which the organism learns to adapt its responses to these varying conditions works out somewhat as follows: First of all, something happens to disturb its placidity. This disturbance may originate within the organism or it may come from without, that is to say, it may begin either with the interoceptors or the exteroceptors (see pp. 86 ff.). Hunger is an example of the first type; a loud sound that causes one to start and catch the breath is an example of the second. At a less primitive level we have such conditions as anxiety over a coming examination for which one has not made edequate preparation or the sight of a theater sign that makes us want to see the show. We must not get the idea that the disturbance is always or even usually a profoundly uncomfortable one. Much more often it consists in the awakening of a desire, a feeling that however comfortable we may be at present, we should be more comfortable or more satisfied if we could get something we do not have or do something we are not doing or institute some other kind of change in our present condition. The organic disturbance is therefore anything that induces a change in the individual's activity. In an earlier chapter we gave it the name of *motive.*

At first the only motives that are capable of disturbing the baby's psychological equilibrium are simple physiological factors such as hunger, thirst, pain and fatigue, and possibly very strong and sudden stimulation of the external sense organs. For none of these conditions has a perfect self-regulating mechanism by which satisfaction can be obtained without the intervention of outside aid been established before birth. There is nothing comparable to the mechanism by which the infant replenishes his bodily supply of oxygen through breathing and distributes the supply through the action of the heart and arteries to the parts of

the body where it is needed. Since this is the case, the hunger disturbance leads at first to formless, rather than patterned activity. One after another the infant tries out about all the responses in his repertoire. He kicks, tosses about as much as he is able, waves his arms, cries, frets. Sooner or later he is given food and satisfaction arrives. But as a result of all this random and formless activity, leading eventually to satisfaction, certain changes have taken place in the infant himself. The next time a disturbance of the same or similar nature occurs, his behavior will not be quite so formless. He will be a little more likely to repeat certain of his former actions and to omit others. These acts and the objects or persons around him at the time are becoming bound up with the disturbance, on the one hand, and the return to a state of satisfaction, on the other. They are becoming means to an end. In the language of the Gestalt school they are becoming "sign-gestalts"; in more everyday terminology we say that they have ceased to be matters of indifference to the individual but have taken on a particular meaning with reference to a particular need. So the individual who has learned something is no longer quite the same as he was before the learning. He has gained a new readiness to perform certain acts when certain conditions arise, and he has acquired a new kind of responsiveness to certain things in his environment. As learning proceeds his activities become increasingly selective. More and more of the useless random activity disappears. Moreover, in the course of time the persons, objects, and devices by which satisfaction was attained come to be identified with the return to satisfaction. They are regarded as signs that satisfaction is on the way. In time this identification becomes so complete that just the sight of these signs is enough to arouse a condition of striving. That which once satisfied a disturbed condition of the organism, which helped to allay activity, now becomes in its turn capable of arousing a new

activity. The child that was lying contentedly in its crib suddenly begins to fret and coax and may even burst into tears at the sight of its mother a few feet away. The man who is in no particular need of food sees a particularly attractive dish and at once is aware of a craving for it. Through the satisfaction of organic states by means of specific actions, by the utilization of specific objects and the aid of other human beings, these actions, objects, and persons lose their impersonal character. They become goals to be striven for or things to be avoided. They are means to an end or obstacles that lie in the way of it. They are sign-boards that point the way to satisfaction.

"Sign-boards" is perhaps not the best term to use here, because it may give the impression that something new has been created and put there for the express purpose of pointing out the road. The signs with which we are dealing here are the informal kind; things that the individual chances to notice, just as you learn to find your way along an unmarked road by noting such accidental features as trees, houses, rocks, and so on. Two people may learn the same road in this incidental fashion by employing very different cues. Sometimes the two systems are equally good. Sometimes one or both may be badly chosen. The cues may be impermanent, serving for a brief time but soon disappearing and so leaving the individual with nothing to guide him in the future. They may be shifting, sometimes pointing to the right way, sometimes to the wrong way. And finally the whole system may be of such a nature that immediate satisfaction is attained only at the cost of lasting damage to the whole organism. In physiology we see such a mechanism at work when a genuine bodily need is given a spurious satisfaction by means of drugs. In psychology we find that there are many people who have learned to secure a temporary and dangerous satisfaction through such mechanisms as day-dreaming, running away from difficulties that should be

faced, occupying themselves with trivial things as an excuse for not attacking the big ones, or by trying to place the blame for their own failure upon other persons or upon circumstances proclaimed to be beyond their control.

These undesirable patterns of response are learned in exactly the same way as the more desirable ones that lead to real accomplishment and lasting satisfaction. Both have their starting point in something that disturbs the placidity of the organism and throws it into a state of activity that persists until some kind of solution is worked out. In both cases, the progress of learning is marked by a tendency to repeat the actions by which satisfaction was attained; in both cases the external means, the particular devices by which the goal was reached take on the character of signals, of intermediate goals that mark out the pattern to be followed. Although the final goal is satisfaction, this satisfaction may be either genuine or spurious. The particular mechanism employed may be a restorative or only a palliative which allays the disturbance for a time during which serious trouble may develop.

The differences between the normal and the abnormal, the delinquent and the well behaved, the successful and the unsuccessful are in the final analysis ascribable to the particular techniques by which each has learned to find satisfaction. The learning is not equally easy for all individuals. Some are by nature endowed with so limited a range of possible responses that their chances of achieving genuine satisfaction are small unless the demands that are made upon them are simple. For such persons a happy and satisfying life depends upon their being reared in an environment where the goals that are set for them can be attained by means of simple, uncomplicated responses. Others with a larger repertoire of behavior possibilities make use of more complicated mechanisms to achieve their results. But a more complex device is not of necessity a better one. No

matter whether the behavior pattern that is finally adopted is simple or elaborate, if mental health is to be preserved and if life is to acquire its full meaning for each individual, the behavior must satisfy the particular organic need in a way that contributes to the effective working of the organism as an enduring whole.

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